Kansas Hazard Mitigation Plan

2010

By the Kansas Hazard Mitigation Team led by the
Adjutant General's Department
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This plan supersedes the Kansas Hazard Mitigation Plan dated 2007.

BOLD
PLANNING SOLUTIONS

Contents

1 Introduction 1.1
1.2 Purpose 1.1
1.3 Adoption by the State 1.2
1.4 Compliance with Federal Laws and Regulations 1.3
1.5 Authorities 1.4
2 Planning Process 2.1
2.1 Documentation and the Planning Process 2.1
2.1.1 Evolution of the State Hazard Mitigation Plan 2.2
2.1.2 2010 Plan Update Process 2.4
2.2 Coordination among Agencies 2.16
2.3 Integration with Other Planning Efforts, Programs, and Initiatives 2.18
2.3.1 Integration with Local Plans 2.19
2.3.2 Challenges in Integration 2.19
3 Risk Assessment 3.2
3.1 Analysis of State Development Trend 3.3
3.1.1 Growth 3.3
3.1.2 Population 3.3
3.1.3 Social Vulnerability. 3.12
3.1.4 Land Use and Development Trends 3.15
3.1.5 Exposure of Built Environment 3.19
3.2 Hazard Identification. 3.23
3.2.1 State Plan Hazard Identification 3.23
3.2.2 Local Plans Hazard Identification and Risk Assessment 3.33
3.3 Hazard Profiles and Vulnerability 3.34
3.3.1 Agricultural Infestation 3.36
3.3.2 Dam and Levee Failure 3.42
3.3.3 Drought 3.54
3.3.4 Earthquake 3.74
3.3.5 Expansive Soils 3.80
3.3.6 Extreme Temperatures 3.83
3.3.7 Flood 3.93
3.3.8 Fog 3.111
3.3.9 Hailstorm 3.113
3.3.10 Hazardous Materials. 3.132
3.3.11 Land Subsidence 3.155
3.3.12 Landslide 3.159
3.3.13 Lightning 3.163
3.3.14 Major Disease Outbreak 3.168
3.3.15 Radiological 3.176
3.3.16 Soil Erosion and Dust 3.179
3.3.17 Terrorism, Agri-Terrorism, and Civil Disorder 3.183
3.3.18 Tornado 3.186
3.3.19 Utility/Infrastructure Failure 3.209
3.3.20 Wildfire 3.214
3.3.21 Windstorm 3.222
3.3.22 Winter Storm 3.235
3.3.23 Section Summary 3.252

3.4 State Facilities: Vulnerability and Potential Losses *3.253*
3.5 RESOURCES *3.263*

4 Mitigation Strategy. *4.2*
4.1 Mitigation Goals and Objectives *4.2*
4.1.1 2010 Updated Goals and Objectives *4.3*
4.1.2 Process for Updating Goals and Objectives *4.4*
4.2 State Capability Assessment *4.7*
4.2.1 State Agencies and Mitigation-Related Programs *4.8*
4.2.2 State Policies and Regulations *4.31*
4.2.3 State Funding Capabilities *4.33*
4.2.4 Changes in Capabilities since 2007 *4.34*
4.2.5 Assessment of Opportunities for Improvement *4.36*
4.3 Local Capability Assessment *4.43*
4.3.1 Local Policies, Programs, and Capabilities *4.43*
4.4 Mitigation Actions *4.49*
4.4.1 Identifying, Evaluating, and Prioritizing Mitigation Actions *4.49*
4.4.2 2010 Updated Mitigation Actions *4.52*
4.5 Funding Sources *4.58*
4.5.1 Federal Funding Sources *4.58*
4.5.2 State Funding Sources *4.66*
4.5.3 Local Funding Sources *4.66*
4.5.4 Private Funding Sources *4.66*
4.5.5 Funding for Mitigation Actions 2004 to 2010 *4.67*

5 Coordination of Local Mitigation Plans *5.2*
5.1 Local Funding and Technical Assistance *5.2*
5.1.1 Background *5.2*
5.1.2 Process to Provide Local Assistance *5.3*
5.2 Local Plan Integration *5.5*
5.2.1 Review and Approval of Local Plans *5.5*
5.2.2 Linking Local Plans with the State Plan *5.6*
5.2.3 Challenges in Plan Integration *5.7*
5.3 Prioritizing Local Assistance *5.8*
5.3.1 Criteria for Planning Grants *5.8*
5.3.3 Successes and Challenges of Prioritization *5.10*

6 Plan Maintenance Process *6.2*
6.1 Monitoring, Evaluating, and Updating the Plan *6.2*
6.1.1 Plan Monitoring and Evaluation *6.3*
6.1.2 Plan Updating and Maintenance *6.5*
6.1.3 Successes and Challenges to Monitoring, Evaluating, and Updating the Plan *6.8*
6.2 Monitoring Progress of Mitigation Actions *6.9*
6.2.1 Monitoring Action Implementation and Closeouts *6.9*
6.2.2 Reviewing Progress on Achieving Goals *6.11*
6.2.3 Successes and Challenges to Monitoring Progress of Mitigation Actions *6.12*

1 Introduction

This chapter introduces the Kansas Hazard Mitigation Plan; its purpose and organization, provide evidence of plan adoption, and includes assurances regarding compliance with federal statutes and regulations as they pertain to federal mitigation grant funding and the state statutes that authorize mitigation programs and organizations in Kansas.

Kansas has experienced a wide variety of disasters throughout the years. Many events have severely impacted the state's people, property, economy, and environment. According to the Insurance Information Institute, Kansas ranked tenth in 2008 among the United States in terms of catastrophic losses ($638 million).

Kansas is vulnerable to a wide variety of natural, technological, and societal hazards. Therefore, the government of Kansas has made a commitment to develop and implement a statewide mitigation program to eliminate or minimize its vulnerabilities to hazards. As defined by the Federal Emergency Management Agency (FEMA), mitigation is ~~a~~ny sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event." The statewide program is intended to encompass actions by the State of Kansas as well as its local governments. Only through a comprehensive, coordinated effort at all levels can the communities of Kansas become resilient to the effects of future disasters.

To head up this effort, the Kansas Hazard Mitigation Team (KHMT), a cooperative group of representatives of state agencies and other interested parties involved in mitigation, was established in the 1990s to develop and coordinate implementation of a statewide hazard mitigation program.

1.1 Purpose

The purpose of the Kansas Hazard Mitigation Plan is to guide hazard mitigation to better protect the people and property of the state. It demonstrates the state's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. The planning process is continual. The KHMT reviews the plan annually and updates it every three years and or needed based on changes in priorities, disaster events, and funding availability. The next update of the plan is scheduled to begin in January 2013.

This 2010 update to the Kansas Hazard Mitigation Plan details the hazards to which Kansas is most vulnerable and the state's commitment to mitigating them. It was developed by the KHMT pursuant to the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390) and the

implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on January, 2008 (44 CFR §201.4). While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that state hazard mitigation plans must meet in order for a state to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (P.L. 93-288).

Specifically, the purpose of the Kansas Hazard Mitigation Plan and the associated planning process is to:

- Create a statewide vision for a disaster resilient future and define the state's goals for hazard mitigation programming;
- Provide an effective mechanism to promote interagency coordination of Kansas' state agency programs related to hazard mitigation;
- Ensure that all the hazards threatening Kansas are identified, evaluated, and addressed with a priority reflecting the risk they pose to the state;
- Comply with federal requirements as they pertain to mitigation in a coordinated and integrated manner;
- Provide an effective mechanism to plan, budget, monitor, and evaluate mitigation efforts;
- Educate state and local officials, as well as the public, regarding the hazards threatening Kansas and methods to mitigate them; and
- Establish and define programs and policies to improve mitigation planning and programming at the local level.

1.2 Organization

This plan is organized around FEMA's mitigation planning process and is divided into six chapters with supporting appendices:

Chapter 1 **Introduction** includes the state's adoption of the plan and assurances that the state will comply with all applicable federal statutes and regulations.

Chapter 2 **Planning Process** explains the planning process, including how the plan was prepared, who was involved, and how it was integrated with other related planning efforts.

Chapter 3 **Risk Assessment** features the risk assessment, which identifies the type and location of hazards that can affect Kansas, analyzes the state's vulnerability to the hazards identified, and serves as the factual basis for the mitigation strategy.

Chapter 4 **Mitigation Strategy** provides the state's mitigation blueprint. Specifically, it includes goals and objectives, state and local capabilities, mitigation activities, and funding sources.

Chapter 5 **Coordination of Local Mitigation Planning** describes the state's role in funding, developing, coordinating, and approving local mitigation plans, and how the state prioritizes funding for local mitigation plans and projects.

Chapter 6 **Plan Maintenance Process** presents the method the KHMT uses to monitor, evaluate, and update the plan. It also outlines how the state reviews progress on achieving the goals of the mitigation strategy.

1.3 Adoption by the State

IFR REQUIREMENT *201.4(c)(6)*	The plan must: - be formally adopted by the State prior to submittal to [FEMA] for final review and approval
Explanation:	An appropriate body in the State **must** adopt the plan. This could be, for example, the State Legislature or the Governor, depending on the State's established procedures. States with hazard mitigation teams or councils may choose to use these bodies to adopt the plan. At a minimum, the plan **must** be endorsed by the director of the State agency responsible for preparing and implementing the plan, as well as the heads of other agencies with primary implementation responsibilities. Adoption by the State: Demonstrates the State's commitment to fulfilling the mitigation objectives outlined in the plan, and Legitimizes the plan and authorizes the responsible agencies identified in the plan to execute their responsibilities.
Plan Update:	An appropriate body in the State **must** adopt the updated plan regardless of the degree of modifications to the original plan.

The Adjutant General, Director of Emergency Management and Homeland Security adopted this update of the Kansas Hazard Mitigation Plan for implementation on November, 2010. A copy of the plan adoption resolution is available in Appendix A Plan Adoption. The plan had been previously adopted by the Adjutant General on November 26, 2007.

1.4 Compliance with Federal Laws and Regulations

IFR REQUIREMENT *201.4(c)(7):*	The plan must: include assurances that the State will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d).
Explanation:	The section on assurances relates to the State's understanding and accountability in complying with Federal statutes and regulations in effect when it receives grant funding as prescribed in 44 CFR 13.11(c). Additionally, as required in 44 CFR 13.11(d), the State **must** amend its plan to reflect new or revised Federal regulations or statutes, or changes in State law, organization, policy, or State agency operation. The amendment can be added as an annex to the plan and later incorporated into the appropriate section(s) when the plan is formally updated as required in §201.4(d) of the Rule. The resolution of adoption can include a statement assuring FEMA that the State will comply with both of these CFR requirements. The plan **must** include a copy of the resolution of adoption.

This plan was prepared to comply with the requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (as amended by the Disaster Mitigation Act of 2000); all aspects of 44 CFR pertaining to hazard mitigation planning and other activities;

interim final rules and final rules pertaining to hazard mitigation planning and grants; all pertinent presidential directives associated with the U.S. Department of Homeland Security and FEMA; all Office of Management and Budget circulars; and other federal government documents, guidelines, and rules.

The State of Kansas agrees to comply with all federal statutes and regulations in effect with respect to mitigation grants it receives, in compliance with 44 CFR 13.11(c). Revisions to the plan will be made whenever necessary to reflect changes in state or federal laws and statutes as required in 44 CFR 13.11(d). As stated in Section 1.1 Purpose, the KHMT reviews the plan annually and updates it every three years or as needed based on changes in priorities, disaster events, and funding availability. Amendments will be made as necessary to address changes in federal and state statutes, regulations, and policies. The next update of the plan is scheduled to begin in January 2013.

1.5 Authorities

The Kansas Hazard Mitigation Plan is an integral component of state-level programs for management of disasters and their impacts. As such, the strategy relies on the authorities given to the programs and organizations herein incorporated for implementation of its strategies and assignments. Further, the plan is intended to be consistent with and supportive of the policies, plans, and implementation procedures that govern mitigation-related state agency programs. In the event of any inconsistency, state agency policies and programs supersede the provisions of this plan. The state's mitigation strategy relies upon and is intended to be consistent with the following Kansas statutes:

Chapter 12, Article 7, allowing cities and municipalities to designate flood zones and restrict the use of land within these zones.

Chapter 24, Article 12, establishing watershed districts.

Chapter 31, Article 1, establishing the state fire marshal's office.

Chapter 48, Article 9, promulgating the Kansas Emergency Management Act, establishing the Division of Emergency Management under the direction of the Adjutant General, and requiring counties to establish and maintain a disaster agency responsible for emergency management and to prepare a county emergency response plan.

Chapter 65, Article 57, promulgating the Kansas Emergency Planning and Community Right-to-Know Act, and establishing the state emergency response commission (Commission for Emergency Preparedness and Response).

Chapter 66, Article 18, promulgating regulations for utility damage prevention (the Kansas Underground Utility Damage Prevention Act).

Chapter 68, Articles 9 & 15, controlling the damming of watercourses.

Chapter 74, Article 26, establishing the Kansas Water Office and Kansas Water Authority and requiring the development of a state plan for water resource management.

2 Planning Process

This chapter documents the process used to develop this plan, including how the state coordinates its efforts with other agencies and planning efforts. The chapter is divided into three parts:

Documentation of the Planning Process
Coordination among Agencies
Integration with other Planning Efforts

2.1 Documentation of the Planning Process

IFR REQUIREMENT *201.4(c)(1):*	[The plan must include a] description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.
Explanation:	A description of the planning process **must** include how the planning team or committee was formed, how input was sought from individuals or other agencies, and how the plan was prepared.
Plan Update:	A description of the planning process is required for the update. The update **must** describe the process used to review and analyze each section of the plan. If the planning team or committee finds that some sections of the plan warrant an update, and others do not, the process the team undertook to make that determination **must** be documented in the plan.

The process established for this planning effort is based on the Disaster Mitigation Act of 2000 planning and update requirements and the Federal Emergency Management Agency's (FEMA) associated guidance for state hazard mitigation plans. The Kansas Hazard Mitigation Team followed FEMA's recommended four-step mitigation planning process:

- Identify and organize available resources
- Identify hazards and assess risk
- Develop a mitigation strategy and mitigation plan
- Implement the plan and monitor progress

The Kansas statewide mitigation-planning program is designed to coordinate the efforts of many state agencies and organizations in mitigation planning and programming on an ongoing basis. It is also intended to actively promote and coordinate mitigation planning and programming by local jurisdictions. Specifically, mitigation planning in Kansas is designed to:

- Encourage and facilitate a multi-organizational, multi-jurisdictional approach to mitigation planning, striving to develop interrelated and coordinated plans and programs at both the state and local levels;

- Use a consistent and valid, but practical, technical approach to mitigation plan development to allow statewide comparability of information, regardless of the jurisdiction or level of government;
- Promote a mitigation planning process that prioritizes available time and resources to address the highest risk hazards confronting the communities of Kansas and the mitigation goals that have been established at the state and local levels; and
- Recognize that mitigation planning and programming must be an ongoing process that can never be fully completed due to continual changes in the communities of Kansas, in the hazards they confront, as well as the resources and capabilities available to mitigate vulnerabilities to those hazards.

2.1.1 Evolution of the State Hazard Mitigation Plan

Kansas Hazard Mitigation Team

The development, implementation, and maintenance of the Kansas Hazard Mitigation Plan are the responsibility of the Kansas Hazard Mitigation Team (KHMT). The KHMT is made up of representatives of the principal state agencies and organizations with authorities, responsibilities, or expertise related to hazard mitigation programs. The Kansas Commission on Emergency Planning and Response chartered the KHMT in 2001. The charter for the KHMT, which is provided below, stipulates its duties, membership, and responsibilities.

Charter of the Kansas Hazard Mitigation Team

1. Purpose: To assess hazard mitigation needs, develop and implement statewide hazard mitigation policies, promote coordination of mitigation programs at all levels of government; pursue alternate mitigation funding strategies;
2. Powers and Responsibilities: The Kansas Hazard Mitigation Team shall have the following functions, powers, and duties:
    a. The development and maintenance of an effective statewide Hazard Mitigation Program, involving all levels of government encouraging government officials to continually strive to promote Hazard Mitigation, and develop disaster cost-reduction initiatives.
    b. Determination of the capabilities of each State and Federal agency to address various hazards, including the legal authority of each agency and the programs and funding sources available to address mitigation activities;
    c. Active participation in the development, implementation and maintenance of a comprehensive State Hazard Mitigation Plan, with the support of the Division of Emergency Management, Adjutant General's Department;
    d. Designate teams to focus on researching, developing, reviewing, specific policies or processes of various hazard mitigation aspects;
    e. Coordinate all hazard reduction programs, objectives and procedures to carry out these objectives through
        i. Coordinated strategies to further common program objectives,
        ii. Identification and evaluation of common priorities for each program,
        iii. Review and make recommendations on applications for program assistance,
        iv. Coordination of mitigation activities with local and Federal government programs,
    f. Propose statewide mitigation policies to the Governor, Commission on Emergency Planning and Response, and agency heads.
    g. Recommend methods to improve mitigation activities of State agencies, local governments, Federal government, and private industry; and
    h. Review grant applications to make funding recommendations to appropriate agencies, and
    i. Seek innovative means to effect solutions to known hazards.
    j. The Adjutant General's Department, Division of Emergency Management, shall provide staff support for the Kansas Hazard Mitigation Team.
3. Membership:
    a. Core Hazard Mitigation Team will be composed of authorized representative(s) from:
        i. Adjutant General's Department
        ii. Kansas Department of Agriculture

iii. Kansas Department of Commerce and Housing
iv. Kansas Department of Health and Environment
v. Kansas Department of Transportation
vi. Kansas Legislative Research Department
vii. Kansas State Historical Society
viii. Kansas Water Office ix. Kansas Wildlife and Parks

b. The Kansas Hazard Mitigation Team's membership may be expanded, when additional expertise is needed for specific hazards, to include the following state, agencies:
   i. Kansas Biological Survey
   ii. Kansas Corporation Commission
   iii. Kansas Department of Administration
   iv. Kansas Department of Education
   v. Kansas Department of Human Resources
   vi. Kansas Department on Aging
   vii. Kansas Forest Service
   viii. Kansas Geological Survey
   ix. Kansas Highway Patrol
   x. Kansas Insurance Department
   xi. Kansas State Fire Marshal's Office
   xii. State Conservation Commission

c. To ensure representation of Federal partners the following agencies will be invited to participate on the team:
   i. Federal Emergency Management Agency
   ii. Housing and Urban Development
   iii. National Weather Service
   iv. U.S. Army Corps of Engineers
   v. US Department of Agriculture
   vi. US Department of Health and Human Services
   vii. US Department of Interior, Bureau of Reclamation
   viii. US Economic Development Agency
   ix. US Geological Survey
   x. US Railroad Administration
   xi. US Small Business Administration

d. To ensure representation of local governments the following associations will be invited to participate on the team:
   i. Kansas League of Municipalities
   ii. Kansas Association of Conservation Districts
   iii. Kansas Association of Counties
   iv. Kansas Rural Water Association
   v. State Association of Kansas Watersheds

4. Chairperson: Selected annually by the Core Hazard Mitigation Team members.
5. Vice-Chairperson: Designated by the Chairperson.
6. Frequency of Meetings and Time Allotted: The Kansas Hazard Mitigation Team shall have authority to convene as necessary, and the Chairperson will be responsible for finalizing agenda issues and determining meeting times.
7. Level of Empowerment: provide advice, assistance and make recommendations, evaluation and endorsement of mitigation projects. H. Feedback: Publish meeting summaries. Report to the Kansas Emergency Preparedness and Response Commission on a semi-annual basis.

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Previous State Mitigation Plans

The initial version of the Kansas Hazard Mitigation Plan was titled the Kansas Hazard Mitigation Strategy. The January 2002 version described a long-term plan for state-level actions needed to improve hazard mitigation programs throughout Kansas to create a more disaster-resilient state. In 2004, this plan was updated according to the FEMA guidance developed to meet the requirements of the Disaster Mitigation Act of 2000. With contracted assistance, the state entered the plan into mitigation planning software. This created a database repository of the plan, but the hard copy version, while very detailed, was not considered user friendly. During the

previous update, the plan underwent a significant overhaul, was converted into a common word processing program and was reorganized to follow the FEMA planning guidance and state plan review crosswalk. The goal was to produce a plan that was easier to use, review, and update. For the 2010 update, it was determined that the word processing program was the most efficient and easy to read format; therefore, the committee elected to maintain the previous plan format.

Another goal of the updated planning process was to simplify the KHMT from five committees (Steering, Planning, Training, Grants Management, and Codes and Regulations) to one general team. The use of KHMT members in separate committees did not lend itself to effective plan updating. For the 2010 update, the planning team was split into two teams, the Core Planning Team and the Specialized Hazards Team.

2.1.2 2010 Plan Update Process

The Kansas Division of Emergency Management (KDEM) initiated the process to update the Kansas Hazard Mitigation Plan in August of 2009. This section describes who was involved in the planning process and how KDEM took the lead role in the plan update in 2010. The state hazard mitigation officer was the planning lead. A planning company was contracted, under a standing contract with the state for mitigation services, to facilitate the planning process and update the plan per the FEMA state plan update guidance. The contractor performed the more labor-intensive tasks, such as updating and improving the risk assessment, facilitating meetings, and keeping the planning process on track. The contracted company used the KDEM website for the plan update to share documents and data during the process. The site was also used to share drafts of the mitigation plan for KHMT review. Table 2.5, later in this section, summarizes how each plan section was reviewed and updated.

Coordination with the Kansas Hazard Mitigation Team

Various state and federal agencies were invited by KDEM to participate in the KHMT for the 2010-plan update. The agencies' participation was based on their previous involvement with state mitigation planning activities, the KHMT charter, or their stake in reducing hazard losses in Kansas. Letters inviting participation were e-mailed to targeted agencies in August of 2009. These letters were addressed to the head of each agency. The letters requested that a representative from the respective agency attend and participate in the meetings of the KHMT. Copies of these letters are on file at KDEM in a planning reference notebook. Representatives designated by agencies were added to a master participants list and informed of meetings and announcements through subsequent emails.

State agency participation was defined early in the planning process and presented at the KHMT kickoff meeting. Participation guidance asked KHMT members to:

- Attend meetings
- Provide requested data
- Participate in planning team development of new projects and initiatives
- Report status of mitigation projects that their agency was responsible for
- Review their agency's responsibilities and make changes as necessary

At the kickoff meeting, the planning team discussed the purpose and requirements of the state plan update, the project's scope of work and schedule, and the responsibilities of the KHMT members. Table 2.1 lists the dates and purposes of the KHMT meetings during the 2010 update

planning process. Table 2.1 illustrates the KHMT involvement during the plan update meetings. Agendas, sign-in sheets, and other materials from these meetings are compiled in a planning reference notebook on file at KDEM. The results of these meetings are incorporated into the remaining chapters of this plan, where more detail on the meetings themselves can be referenced.

Table 2.1 Meetings of the KHMT during the 2010 Plan Update Process

Meeting	Date	Purpose
1. Project Kickoff	12/02/2009	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of KHMT • Discuss data collection needs
2. Risk and Capability Assessments	02/24/2010	• Review and comment on updated risk assessment • Review and assess state and local mitigation capabilities • Review and verify CPRI index for hazard rankings • Introduce methodology for updating goals and objectives • Introduce methodology to record progress of mitigation actions from 2007
3. Mitigation Strategy	06/09/2010	• Approve updated goals and objectives • Review and approve state mitigation criteria for evaluation and prioritization • Develop priority mitigation actions • Review and update plan maintenance and implementation strategy
Meetings of the KHMT Prior to the 2010 Plan Update Process		
KHMT Meeting	01/03/2008	• Information to charter the KHMT • Membership staffing of other agencies • By-law questions • HMGP Funding • DFIRM status
KHMT Meeting	04/03/2008	• Local hazard mitigation plans progress report • HMGP funding status • Buyout information for FEMA DR-1711 • Review Kansas Hazard Mitigation Plan Chapter 3
KHMT Meeting	11/13/2008	• ISO rating information • Charter membership information • Hazard risk rating discussion • Automated weather stations discussion
KHMT Meeting	02/05/2009	• Local mitigation plan overview • Mitigation projects overview • Review State Hazard Mitigation Plan Chapter 4 Discussion on Goals and Objectives
KHMT Meeting	05/13/2009	• Local Hazard Mitigation Plan overview • Mitigation projects overview • Review State Hazard Mitigation Plan Chapter 5
KHMT Meeting	06/24/2009	• Mitigation project overview • Mitigation plan overview • Kansas Water Office Flood Plan Management discussion
KHMT Meeting	08/19/2009	• Hazard Mitigation progress report • Local mitigation plans progress report • Kansas Water Office Flood Plan Management discussion

Table 2.2 and 2.3 document the participation of each agency at these KHMT meetings. The tables also show how participation changed from 2007 to 2010 and documents what agencies

and entities were solicited to participate in the plan. While not every agency was represented at planning meetings, many were able to remain involved by individually reviewing and commenting on the draft plan. The draft plan was handed out at these meetings and each individual was given the opportunity to review each section. The plan was also posted on the KDEM website to allow agencies and individuals who could not attend the meeting to review and analyze each section. Targeted outreach efforts were made by the state hazard mitigation officer and planning contractor to certain agencies during the planning process, as needed. The ―Other" column in Table 2.4 indicates those agencies that reviewed and provided comments on the plan or were not able to attend meetings but provided input through email or telephone conversations. Located on page 2.12 is the invitation sent for participation in the Mitigation Planning process.

The Hazard Mitigation Team was divided into two groups: the Core Planning Team, and the Specialized Planning Team. Participants in both teams are presented in Tables 2.2 and 2.3.

Table 2.2 2010 Core Hazard Mitigation Team Members (Current)

Agency/Division	Representative Name	Representative Email	Representative Phone Number
Adjutant Generals Department			
Army National Guard	Jessica Frye	jessica.p.frye@us.army.mil	785.274.1610
Emergency Management Division	Jacob Gray	jacob.s.gray@us.army.mil	785.274.1973
Planning and Mitigation Branch Director	Brandt Haehn	brandt.k.haehn@us.army.mil	785.274.1431
Hazard Mitigation Program Specialists	Charlie McGonigle	charlie.e.mcgonigle@us.army.mil	785.274.1421
Mitigation Planner	Brad Moeller	bradley.r.moeller@us.army.mil	785.274.1840
Hazard Mitigation Program Specialists	Chris Welsh	christopher.a.welsh@us.army.mil	
Emergency Management Division - Tech Hazards	S. Kim Nettleton	kim.nettleton@us.army.mil	785.274.1423
Data Access and Support Center	Ken Nelson	dasc@kgs.ku.edu	785.864.2000
Department of Agriculture			
Department of Agriculture, Division of Water Resources	Tom Morey	tom.morey@kda.ks.gov	785.296.5440
	Steve Samuelson	steve.samuelson@kda.ks.gov	785.296.4622
Department of Commerce and Housing (now Dept. of Commerce and Kansas Housing Resources Corp.)			
Department of Commerce	Joe Monaco	jmonaco@kansascommerce.com	785.296.3760
Kansas Housing Resources Corporation	Steve Weatherford	info@kshousingcorp.org	785.296.5865
Department of Health & Environment			
Air Operating Permit & Compliance	Pat Simpson	psimpson@kdheks.gov	785.296.1593
Bureau of Environmental Remediation	Gary Blackburn	gblackburn@kdheks.gov	785.296.1660
Bureau of Water	Karl Mueldener, Dir.	kmuelden@kdheks.gov	785.296.5509
Department of Health & Environment	Michael McNulty	mmcnulty@kdheks.gov	785.291.3065
Kansas Department of Transportation			
Division of Operations	Mark Krentz	krentz@ksdot.org	785.231.4934
Kansas Legislative Research Department	Contacted		
Kansas State Historical Society			

	Rebecca Martin	rmartin@kshs.org	785.272.8681, ext. 426
Kansas Water Office			
	Bobbi Wendt	bobbi.wendt@kwo.ks.gov	785.296.3185
Department of Wildlife and Parks			
Department of Wildlife and Parks	Rob Ladner	robl@wp.state.ks.us	785.273.6740
Environmental Services Section	Contacted		
Bold Planning Solutions	Fulton Wold	fulton@boldplanning.com	615.469.5558

Table 2.3 2010 Specialized Hazards Team Members (Current)

Agency/Division	Representative Name	Representative Email	Representative Phone Number
Kansas Emergency Management Association	Teri Smith	tsmith@douglas-county.com	785.838.2460
	Rodney Job	icem@lincolncoks.org	785.524.5005
Commission on Emergency Planning and Response	John Prather	jprather@groendyke.com	316.321.6378
National Weather Service - Topeka	Chad Omitt	chad.omitt@noaa.gov	785.232.0814
Kansas Corporation Commission	Leo Haynos	l.haynos@kccs.gov	785.271.3278
Division of Administration			
Division of Facilities Management	Gary Hibbs	gary.hibbs@da.ks.gov	785.296.1318
Kansas Information Technology Office	Ivan Weichart	ivan.weichert@da.ks.gov	785.296.0257
Department of Social and Rehabilitation Services	Cindy Morris	cindy.morris@srs.ks.gov	785.296.3158
Department of Human Resources (now Department of Labor)	Steve Zink	steve.zink@dol.ks.gov	785.296.4386
Kansas Forest Service	Ross Hauck	rhauck@ksu.edu	785.532.3314
Kansas Geological Survey	Rex Buchanan	rex@kgs.ku.edu	785.864.2106
Kansas Highway Patrol	Eric Pippin	epippin@khp.ks.gov	785.296.8087
Emergency Operations Section	Melanie Lawrence	melanie.a.lawrence@us.army.mil	785.296.6654
Kansas Insurance Department	Daryl Richardson	drichard@ksinsurance.org	785.296.3071
Kansas State Fire Marshall	Becky Bahr	becky.bahr@ksfm.ks.gov	785.296.0697
State Conservation Commission	Hakim Saadi, P.E.	hakim.saadi@scc.ks.gov	785.291.3099

US Army Corps of Engineers Silver Jackets	Brian Rast	brian.t.rast@usace.army.mil	816.389.3337
	John Robinson	john.t.robinson@usace.army.mil	816.389.2174
	John Grothaus	john.j.grothaus@usace.army.mil	816.389.3110
US Army Corps of Engineers - Tulsa District	Peter Navesky	peter.navesky@usace.army.mil	918.669.7325
US Bureau of Reclamation - Great Plains District	Nancy Striker	nstriker@usbr.gov	308.345.1028
University of Kansas - Biological Survey	Kevin Dobbs	kevindobbs@ku.edu	785.864.1512
University of Kansas - Dept. of Geography	Mark Bowen	mwbowen@ku.edu	
Kansas State University - Entomology	Robert Whitworth	jwhitwor@ksu.edu	785.532.5656
FEMA Region VII	Melissa Janssen	melissa.janssen@dhs.gov	816.283.7012
	Joe Chandler	joe.chandler@dhs.gov	816.283.7071
US Housing and Urban Development	Contacted		
Wolf Creek Generating Plant	Contacted		
National Weather Service, Wichita	Contacted		
National Weather Service, Dodge City	Contacted		
National Weather Service, Goodland	Contacted		
National Weather Service, Hastings	Contacted		
National Weather Service, Kansas City	Contacted		
National Weather Service, Springfield	Contacted		
US Department of Agriculture	Contacted		
US Department of Health and Human Services	Contacted		
US Economic Development Agency	Contacted		
US Geological Survey	Contacted		
Federal Railroad Administration	Contacted		
US Small Business Administration	Contacted		
Kansas Antiquities	Contacted		

Commission			
Kansas Association of Counties	Contacted		
Kansas League of Municipalities	Contacted		
Kansas Association of Conservation Districts	Pat Lehman	ptlehman@kacdnet.org	785.832.9400
Kansas Association for Floodplain Management	Contacted		
State Association of Kansas Watersheds	Barb Oltjen	wrws@rainbowtel.net	785.544.6686
Kansas Animal Health Department	Karen Domer	kdomer@kahd.ks.gov	785.296.2326
Kansas Collaborative	Kathleen Harnish-Doucet	kathleen@teamtechinc.com	913.492.4797
Kansas Department of Corrections	Charles Simmons	kdocpub@doc.ks.gov	785.296.5187
Kansas State University Extension Service	Daryl Buchholz	dbuchhol@ksu.edu	785.532.5820
Kansas Rural Water Association	Contacted		
Kansas Electric Cooperatives, Inc.	Contacted		
Kansas Electric Power Cooperative (KEPCo)	Contacted		
Kickapoo Tribe in Kansas	Luke Terry	luke.terry@ktik-nsn.gov	785.486.2601ext 1
Prairie Band Pottawatomi Nation	Steve Duryea	sduryea@pbpnation.org	785.966.2946
Sac and Fox Nation of Missouri	No Contact		
Iowa Tribe of Kansas and Nebraska	Contacted		
Kansas Municipal Utilities	Brad Mears	bmears@kmunet.org	620.241.1423
Bold Planning Solutions	Fulton Wold	fulton@boldplanning.com	615.469.5558

Table 2.4 Participation of State Agencies in the 2010 Plan Update Process

Agency/Division	Participated in 2004 Plan	Participated in 2007 Plan	Participated in 2010 Plan	Meeting 1	Meeting 2	Meeting 3	Other
State Agencies							
Adjutant General's Department	X	X	X	X	X	X	X
Kansas Animal Health Department							X
Kansas Board of Regents		X					
Kansas Commission on Veterans Affairs		X					
Kansas Corporation Commission		X	X		X		
Kansas Department of Administration	X	X	X	X	X		X
Kansas Department of Aging		X					
Kansas Department of Agriculture	X	X	X	X	X	X	X
Kansas Department of Commerce	X	X					
Kansas Department of Corrections	X	X		X			
Kansas Department of Education		X					
Kansas Department of Health and Environment		X	X	X	X	X	X
Kansas Department of Labor		X			X	X	X
Kansas Department of Social and Rehabilitative Services		X			X	X	X
Kansas Department of Transportation		X	X	X	X		X
Kansas Department of Wildlife and Parks		X					
Kansas Forest Service	X	X	X	X	X		
Kansas Geological Survey	X	X	X				
Kansas Highway Patrol	X	X	X	X	X	X	X
Kansas Insurance Department		X					
Kansas State Fire Marshal's Office	X	X	X				X
Kansas State Historical Society	X	X			X	X	X
Kansas State University	X	X				X	X
Kansas Water Office	X	X	X	X	X	X	X
State Conservation Commission	X	X				X	X
University of Kansas—Biological Survey		X					
Local Stakeholders							
Butler County Emergency Management/Homeland Security		X			X		
City of Hutchinson	X						

Agency/Division	Participated in 2004 Plan	Participated in 2007 Plan	Participated in 2010 Plan	Meeting 1	Meeting 2	Meeting 3	Other
Police Department							
Kansas Association of Counties		X					
Kansas League of Municipalities		X	X				
Sedgwick County Emergency Management	X						
Tribal Stakeholders							
Iowa Tribe of Kansas and Nebraska		X					
Kickapoo Tribe in Kansas		X					
Prairie Band Pottawatomie Nation		X					
Sac and Fox Nation of Missouri		X					
Federal Stakeholders							
Bureau of Reclamation—Great Plains District	X	X					
FEMA Region VII		X		X	X		
National Weather Service—Topeka		X			X	X	
U.S. Army Corps of Engineers—Kansas City District	X	X					
U.S. Army Corps of Engineers—Tulsa District		X					
Private Stakeholders							
Astaris L.L.C.		X					
Central Plains Laboratory	X	X					
Wolf Creek Nuclear Operating Corporation		X			X	X	
Professional Associations and Other groups							
Kansas Antiquities Commission		X					
Kansas Association for Floodplain Management		X	X				
Kansas Emergency Management Association	X	X			X		
Kansas Rural Water Association	X	X	X				
Rural Electric Cooperatives		X					

Invitation to participate in the 2010 Mitigation Plan Update meetings

Kansas State Hazard Mitigation Team

The Kansas Hazard Mitigation Team would like to invite your organization to participate in its meetings, which are held on a quarterly basis. The KHMT is composed of personnel from various state, federal and local agencies, whose goal is to discuss and assess hazard mitigation needs, develop and implement statewide policies, promote coordination of mitigation programs at all levels of government and pursue alternate mitigation funding strategies.

We are currently in the process of updating the State Mitigation Plan and would welcome your ideas and input.

Our next meeting will be in either February or March 2010. Please let me know if you are interested and I will put you on our contact list.

Thank you,

Brad Moeller
Hazard Mitigation Planner
Kansas Division of Emergency Management
State Defense Building
2800 SW Topeka Blvd
Topeka KS 66611-1287
Phone: (785) 274-1840
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Plan Section Review and Analysis

During the 2010 plan update, the KHMT updated each of the sections of the previously approved plan to include new information, improve organization, and format the plan's contents. The KHMT analyzed each section using FEMA's state plan update guidance to ensure that the plan met requirements. Table 2.5 briefly summarizes how each section of the plan was reviewed and analyzed to capture changes that occurred since the previous plan was approved. More detailed documentation on updated methodology and processes is provided at the beginning of each plan section. Note that the plan was revised from three main chapters in 2004 titled Planning Process, Risk Assessment, and Mitigation Strategy (and associated attachments with each chapter) to six chapters in 2007. The 2010 update continued using the six-chapter format that was developed in the previous update. The purpose of this revision was to better align the plan with FEMA requirements.

Table 2.5 Summary of Update Review and Analysis of Each Plan Section

2010 Plan Section	Update Review and Analysis
1.0–1.2 Introduction	• Reviewed for currency and updated to meet FEMA requirements
2.0–2.3 Planning Process	• Described planning process for 2010 update and changes to the plan from 2007, including coordination among agencies and integration with other planning efforts • Added tables to show members of both teams of the KHMT
3.1 Analysis of State Development Trends	• Updated section to meet FEMA requirement to analyze growth and development trends • Updated population and housing unit growth trends between 2000-2008 at county level
3.2 Hazard Identification	• Reviewed list of hazards from 2007 with method to determine planning significance
3.3 Hazard Profiles and Vulnerability	• Updated hazard profiles with recent events, as appropriate • Updated vulnerability assessments with county-level data where data permitted • Updated statistical risk assessment methodology to estimate relative vulnerability by county for hailstorm, tornado, windstorm, and winter storm • Updated GIS thematic maps of counties to communicate relative vulnerability for certain hazards • Described changes in growth and development and examined related changes in the context of hazard-prone areas and how the changes affect loss estimates and vulnerability
3.4 State Facilities: Vulnerability and Potential Losses	• Requested updated state facility data; however, the request was denied because there were very few changes in facilities and other undisclosed reasons • Reviewed old state facility database and determined it would be sufficient
4.0 Mitigation Strategy	• Updated based on results of the updated risk assessment, data from the local plans database, completed mitigation actions, and implementation obstacles and opportunities over the last three years
4.1 Goals and Objectives	• Reviewed and evaluated goals and objectives from the last plan update

2010 Plan Section	Update Review and Analysis
4.2 State Capability Assessment	• Reviewed and updated information on state capabilities and included contact information for each department • Discussed changes in state funding capability and the state's policies addressing development in hazard-prone areas • Reviewed obstacles and opportunities associated with capabilities
4.3 Local Capability Assessment	• Updated description of local capabilities • Analyzed effectiveness of local capabilities • Identified obstacles and opportunities to improving local capabilities
4.4 Mitigation Actions	• Reviewed and updated mitigation actions from the last plan • Documented progress of actions since the previously approved plan • Identified high priority existing actions and new actions through a group process
4.5 Funding Sources	• Updated primary funding sources with more detail and updated list of other potential funding sources (see Appendix B Federal Assistance Programs) • Identified funding sources used since previously approved plan
5.0 Coordination of Local Mitigation Planning	• Reviewed process for coordinating local mitigation planning • Updated information on the status of local plan completion and schedule
5.1 Local Funding and Technical Assistance	• Described how the state provided planning and technical assistance to local governments over the last three years • Updated the process for providing local assistance to focus resources on the local plan update process • Summarized current status of county-level hazard mitigation plans
5.2 Local Plan Integration	• Developed database to integrate local planning information to the state plan
5.3 Prioritizing Local Assistance	• Reviewed criteria for prioritizing planning and project grants • Established new priorities for local plan development • Adopted State of Kansas Hazard Mitigation Grant Program Administrative Plan criteria for project grant prioritization
6.0–6.3 Plan Maintenance Process	• Reviewed and updated procedures for monitoring, evaluating, and updating the plan • Updated system for monitoring progress of mitigation activities

Source: FEMA News Photo Greensburg, KS

2.2 Coordination among Agencies

IFR REQUIREMENT *201.4(b):*	The [State] mitigation planning process **should** include coordination with other State agencies, appropriate Federal agencies, interested groups, and .
Explanation:	In order to encourage States to develop plans that will be used as guides for statewide mitigation activities, and for citizens and the private sector to support such activities, the Rule recommends States demonstrate coordination with all levels of government, and representatives from the private and non-profit sectors. The plans *should* describe how the State interacted with Federal, State, regional, and local agencies, as well as other interested parties such as business, industry, and professional associations, non-profit groups, and community representatives in the development of the plan. Of particular importance is the participation by agencies and groups that can contribute resources to prepare the plan and by agencies that will likely implement mitigation actions. By including these agencies in the planning process, the State can build partnerships that will facilitate the implementation phase of the plan. Merely contacting agencies to solicit input or sending a draft plan for an agency to review does not constitute active participation. Participants *should* play an active role throughout the planning process and, whenever possible, be involved from the beginning. The State *should* identify additional participants as opportunities arise (e.g., after a disaster). Examples of how coordination may be demonstrated: Description of outreach efforts to engage interested parties. Description of the types and frequency of meetings of task forces and committees, inter-disciplinary/inter-agency mitigation planning teams, or with interested agencies and private sector organizations. Discussion of the nature of the Memoranda of Understanding (MOU) or other work agreements. Description of how interested parties who could not participate on a regular basis were kept informed and how they provided comments.
Plan Update	The updated plan *should* describe how the State interacted with all levels of government as indicated above. It *should* also describe how coordination among agencies changed since approval of the previous plan.

The previous section, Section 2.1 Documentation of the Planning Process, discussed the agencies invited to participate on the KHMT for the 2010 plan update (state, federal, and interested groups). Members of the KHMT participated in the update process by attending planning meetings, providing data and information, and commenting on the draft version of the plan. Coordination between state and federal agencies has continued to be exceptional. The State of Kansas and federal agencies continue to use all forms of communication to coordinate a multitude of tasks whether it's day-to-day activities or major disasters in the state.

Improvement in coordination among the agencies participating in the plan update was an outcome of the planning process.

Interested groups involved in the recent planning process are listed in Section 2.1. These included the Kansas Emergency Management Association (KEMA), Wolf Creek Nuclear Operating Corporation, and the National Bio and Agro-Defense Facility (NBAF) at Kansas State University. KDEM staff attended the KEMA annual conference and presented a session on local hazard mitigation plans. KDEM staff also attended a FEMA Region VII sponsored training that focused on mitigation planning.

Source: FEMA News Photo Greensburg, KS Cleanup

Hazard mitigation planning involves multiple government agencies, private, professional, and voluntary organizations as well as commerce and industry. Outreach and partnerships with these groups and the public will be expanded in future updates. This plan will be adjusted accordingly to reflect new participants and their roles during the next update.

2.3 Integration with Other Planning Efforts, Programs, and Initiatives

IFR REQUIREMENT *201.4(b):*	The Standard State Plan should be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives.
Explanation:	Coordination can result in identifying opportunities to integrate planning efforts and mitigation actions. FEMA has found that mitigation plan implementation is most effective when States integrate mitigation planning efforts with those of other State planning programs and initiatives. States might demonstrate that they have made efforts at integration by: Reviewing existing plans and reports to identify opportunities to integrate mitigation actions. Having mitigation planners/specialists serve on other State program and planning teams. Consolidating the planning requirements for all State mitigation programs (e.g., HMGP, FMA, CRS, local comprehensive plans, and land use plans). Identifying overall goals or priorities common to other State planning efforts. Requesting that legislation be passed or issuing an Executive Order mandating integration of mitigation actions into other planning initiatives. Outlining the State's approach and providing a timeline for integrating actions. Describing actual ongoing efforts where mitigation actions have been integrated into planning mechanisms (e.g., comprehensive plans, capital improvement plans, and emergency operation plans) and implementation tools (e.g., building codes, floodplain ordinances, and land use regulations).

The State of Kansas is committed to the multi-agency mitigation strategy outlined in this plan. Details on related planning programs and initiatives are discussed and highlighted in Section 4.2 State Capability Assessment. Section 4.4 2010 Updated Mitigation Actions provides additional details on actions designed to improve coordination and integration efforts.

This plan is related to the following plans and procedures:

- Kansas Water Plan, coordinated by the Kansas Water Office
- Kansas Response Plan, coordinated by KDEM
- State of Kansas Hazard Mitigation Grant Program Administrative Plan, coordinated by KDEM
- Kansas Planning Standards, coordinated by KDEM
- Kansas Strategy for Counter Terrorism Program Development, coordinated by the Adjutant General's Department
- Kansas GIS Strategic Plan, coordinated by the Adjutant General's Department
- Continuity of Operations Plan, coordinated by KDEM

Of all these plans, the Kansas Water Plan may be the most important as a related tool for reducing hazard losses. This mitigation plan supplements and supports the projects identified in the Kansas Water Plan that contribute to mitigation of drought, flood, and soil erosion hazards. The Kansas Water Plan is coordinated by the Kansas Water Office and involves multiple state agencies. The State of Kansas Hazard Mitigation Grant Program (HMGP) Administrative Plan outlines the state's policies and procedures for using post-disaster HMGP funds, which could be

used to fund some of the actions identified in this plan. The mitigation plan is also linked by its actions with the Kansas Department of Agriculture Division of Water Resource's programs to manage the National Flood Insurance Program and coordinate statewide floodplain mapping activities.

2.3.1 Integration with Local Plans

KDEM is the primary state coordinating agency for all local emergency operation plans and hazard mitigation plans. The division has the primary responsibility of working with local governments in developing, reviewing, and updating local hazard mitigation plans. This plan outlines the state's strategy for providing assistance to local governments in completing their mitigation plans in Chapter 5 Coordination of Local Mitigation Planning. This plan and its risk assessment provide a baseline reference for communities to use in completing mitigation plans. Integration of local hazard mitigation plans with the state plan will improve as more local plans are completed over time.

2.3.2 Challenges in Integration

One challenge in integrating local plans with the state plan is that only a few of the local hazard mitigation plans were completed and FEMA approved in 2007. During the 2010 revision, still less than 50% of the local plans were completed. However, integration will progress in the future as more local plans are completed and approved by FEMA. Prior to the last update, the organization experienced severe staffing needs within the workforce by having to fill in other vacant positions within the department. Since the previous update, KDEM has staffed its department and is currently up to an adequate personnel level. New employees had to be trained on many state and federal mitigation programs and procedures. Due to the complexity of the state and federal systems, this was a timely task to get all new employees trained and experienced in carrying out the ~~"~~day-to-day" activities to meet state, federal, and local jurisdictional needs.

Another confronting issue with the integration of planning at the state and local levels has been the use of mitigation planning software programs. Initially, the state encouraged the use of two different programs. The programs were discontinued after some local governments experienced difficulty upgrading the version of the software and lost data. While these programs were intended to facilitate the process, they often resulted in ~~"~~boiler plate" plans. Currently, the state allows more flexibility for how local governments prepare plans.

KDEM has developed a local plan database with the assistance of Bold Planning Solutions. All the FEMA-approved plan's pertinent information will be entered into the database. This will allow KDEM to have the local plan ~~"~~goals, objectives, and mitigation action items" readily available for examination in the event of a funding surplus. The availability of FEMA grant programs or any other accessible funding source that becomes obtainable will be correlated to this local plan database. This allows KDEM to locate the best existing mitigation endeavors that meet the mitigation goals of the State's Hazard Mitigation Plan.

3 RISK ASSESSMENT

The foundation of the Kansas Hazard Mitigation Plan is the statewide risk assessment. In order to define effective mitigation actions to make Kansas more resilient to the impacts of future disasters, it is necessary to understand the hazards that threaten the state and how they disrupt Kansas communities. It is also necessary to understand how the communities are vulnerable to the impacts of the identified hazards and the scope or extent of that vulnerability. This chapter details the risk assessment process conducted by the Kansas Hazard Mitigation Team (KHMT). Its purpose is to provide, on a statewide basis, an understanding of the risks posed by the hazards that threaten Kansas. This allows the KHMT to focus its planning efforts on the hazards that pose the most risk to the people of Kansas, their property, and their communities.

The Federal Emergency Management Agency (FEMA) defines risk assessment terminology as follows:

- **Hazard**—A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing.
- **Vulnerability**—Vulnerability is susceptibility to physical injury, harm, damage, or economic loss. It depends on an asset's construction, contents, and economic value of its functions.
- **Exposure**—Exposure describes the people, property, systems, or functions that could be lost to a hazard. Generally, exposure includes what lies in the area the hazard could affect.
- **Risk**—Risk depends on hazards, vulnerability, and exposure. It is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. It refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.
- **Risk Assessment**—Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

The risk assessment in this 2010 plan update is based on the assessments from the 2002, 2004, 2007 plans, and has been updated to reflect recent events, the availability of new information, and a reevaluation of the hazards that threaten Kansas. This chapter has been reorganized and is broken down into four sections:

- **Analysis of State Development Trends** —This section looks at population changes, social vulnerability, land use and development trends, and building exposure. This was added to the plan in the previous update.
- **Hazard Identification**—This section identifies the hazards of greatest concern to Kansas and how and why they were identified.
- **Hazard Profiles and Vulnerability**—This section describes each hazard identified in the previous section, discusses where in the state the hazard is most likely to occur, gives examples of previous occurrences, states the probability of occurrence, and analyzes the vulnerability and potential losses by jurisdiction (county), which includes discussions on development in hazard-prone areas. New methods to refine relative vulnerability county by county to tornado, flood, windstorm, winter storm, and hailstorm were added previously.

- **State Facilities: Vulnerability and Potential Losses**—This section addresses the vulnerability and potential loss to state owned or operated critical facilities and infrastructure from the more significant hazards.

Like any other aspect of planning, hazard identification and vulnerability assessment is an ongoing, continually evolving process. This plan incorporates efforts to not only improve the knowledge of the KHMT, stakeholders, and citizens regarding the hazards known to threaten the state but also to assess if previously unidentified natural, technological, or manmade hazards need to be addressed by the Kansas Hazard Mitigation Plan.

3.1 Analysis of State Development Trends

Development, demographic, and land use trends along with building value exposure are important elements to consider in a risk assessment. This section will examine growth, social vulnerability, other demographics, land use and development trends, and exposure of the built environment as inputs to the vulnerability discussions that will take place by hazard in Section 3.3 Hazard Profiles and Vulnerability.

3.1.1 Growth

As part of the plan update process, the state looked at changes in growth and development and examined these changes in the context of the state's hazard-prone areas and how the changes in growth and development affect loss estimates and vulnerability. When the population in a hazardous area increases, so does the vulnerability of people and property associated with the hazards unless mitigation measures are taken. Recognizing both the population growth trends and the geographic locations of the growth patterns within the state is necessary to understand this issue. The discussion here focuses on population growth and increases in housing units and density by county, based on U.S. Census Bureau data.

3.1.2 Population

The U.S. Census Bureau estimates Kansas' 2009 population at 2,818,747. This reflects an increase of 4.6% between 2000 and 2009. In 2009, Kansas ranked 33rd among the 50 states in population, 38th in rate of growth, 13th in land area, and 40th in population density (based on 81,815 square miles as reported in the 2000 census). Decennial census findings from the last few decades illustrate growth in Kansas (see Table 3.1). In 2010 the Census Bureau will be completing their decennial census; however the census has not been completed at the time of this plan revision.

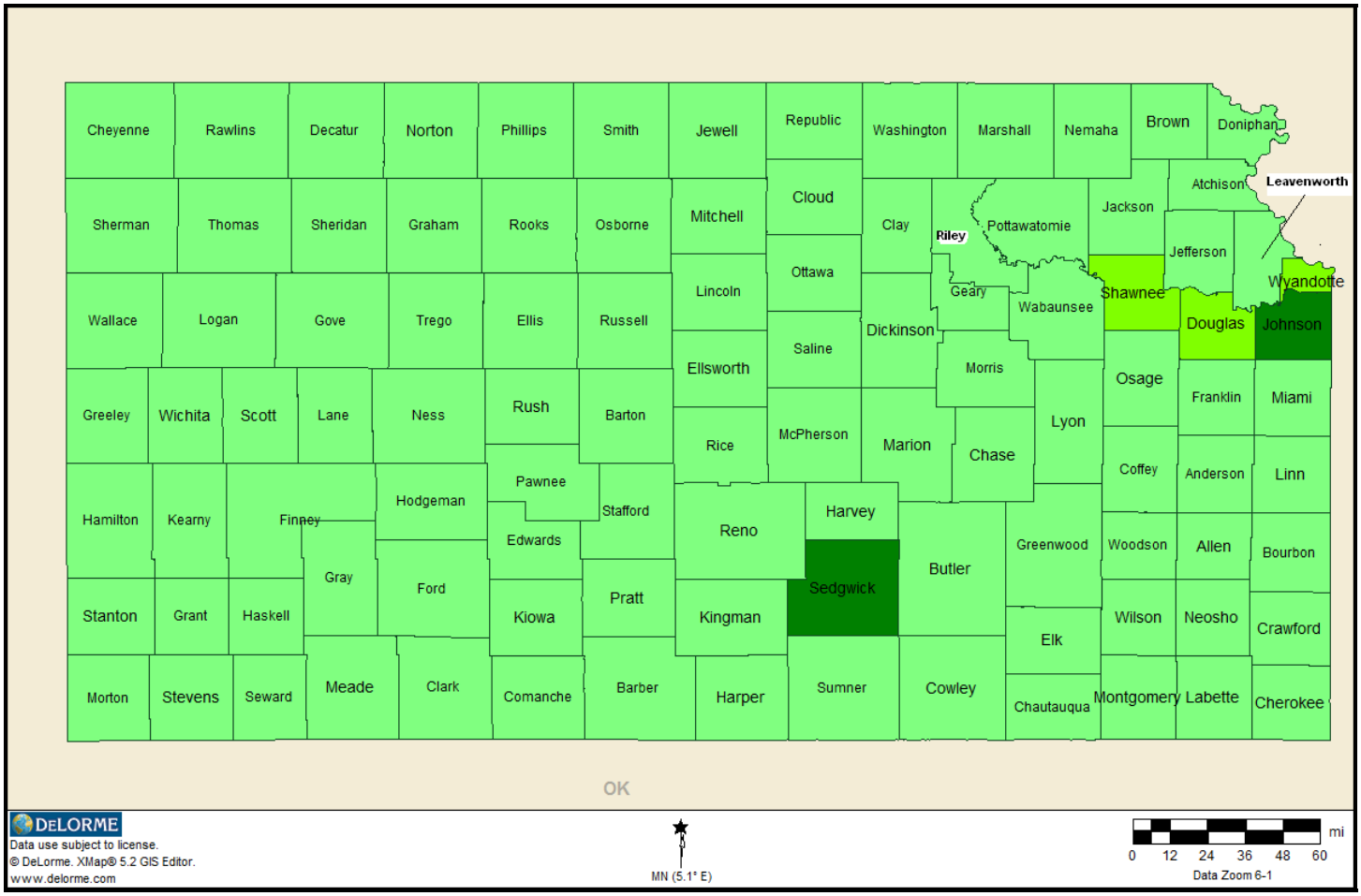
Table 3.1. Kansas' Decennial Census 1970–2000

Year	Population	% Change
1970	2,246,578	+3.1
1980	2,363,679	+5.2
1990	2,477,574	+4.8
2000	2,688,418	+8.5

Source: U.S. Census Bureau 2002, www.census.gov

Between 2000 and 2009, 21 Kansas counties increased in population. With the exception of Ford, Finney, Seward, Ellis, and Gray counties, the growth was concentrated in the eastern half of the state, specifically in the contiguous counties near the metropolitan areas of Kansas City and Lawrence (Johnson, Douglas, Miami, Leavenworth, and Franklin), and also around Manhattan and Fort Riley (Riley, Wabaunsee, Pottawatomie, Geary, Clay, and Dickinson). Johnson County, the largest county in Kansas, gained the most people and is growing the fastest (percent change). According to the Governor's Economic and Demographic Report 2006-2007, as the population in Kansas continues to increase, the cities with populations of more than 5,000 are realizing the greatest proportion of the increase. The report notes that while historically Kansas has been predominantly rural, the trend is changing. Figure 3.1 shows Kansas' 2009 estimated population by county. Tables 3.2, 3.3, and 3.4 show the top 10 Kansas counties ranked by estimated population and those with the greatest estimated population gains. Figure 3.2 shows Kansas' estimated percentage changes in population by county. Between 2000 and 2009, 84 counties in Kansas had a decrease in population (see Tables 3.5 and 3.6). Table 3.7 shows the 10 least populous counties in Kansas.

Figure 3.1. Kansas Estimated Population by County, 2009



427,530 – 542,737

107,832 – 214,397

1,266 – 107,831

Source: U.S. Census Bureau 2009, www.census.gov. Map prepared by Bold Planning Solutions.

Table 3.2. Top 10 Counties Ranked by Population (Estimated), 2009

County	2009 Population
Johnson	542,737
Sedgwick	490,864
Shawnee	176,255
Wyandotte	155,085
Douglas	116,383
Leavenworth	75,227
Riley	71,341
Butler	64,084
Reno	63,357
Saline	54,364

Source: U.S. Census Bureau 2009, www.census.gov

Table 3.3. Ten Counties with Greatest Estimated Population Gains (Numerical), 2000–2009

County	Population Gain 2000-2009
Johnson	65,645
Sedgwick	18,026
Douglas	12,161
Leavenworth	4,937
Butler	3,665
Shawnee	2,822
Miami	2,549
Franklin	1,729
Ford	1,325
Pottawatomie	1,011

Source: U.S. Census Bureau 2009, www.census.gov

Table 3.4. Ten Counties with Greatest Estimated Population Gains (Percent), 2000–2009

County	Population Gain (%) 2000-2009
Johnson County	16.97
Douglas County	13.93
Riley County	12.25
Geary County	11.52
Miami County	8.96
Pottawatomie County	7.91
Leavenworth County	7.86
Franklin County	6.96
Butler County	6.66
Sedgwick County	6.45

Source: U.S. Census Bureau 2009, www.census.gov

Figure 3.2. Estimated Percent Change in Population by County, 2000–2009

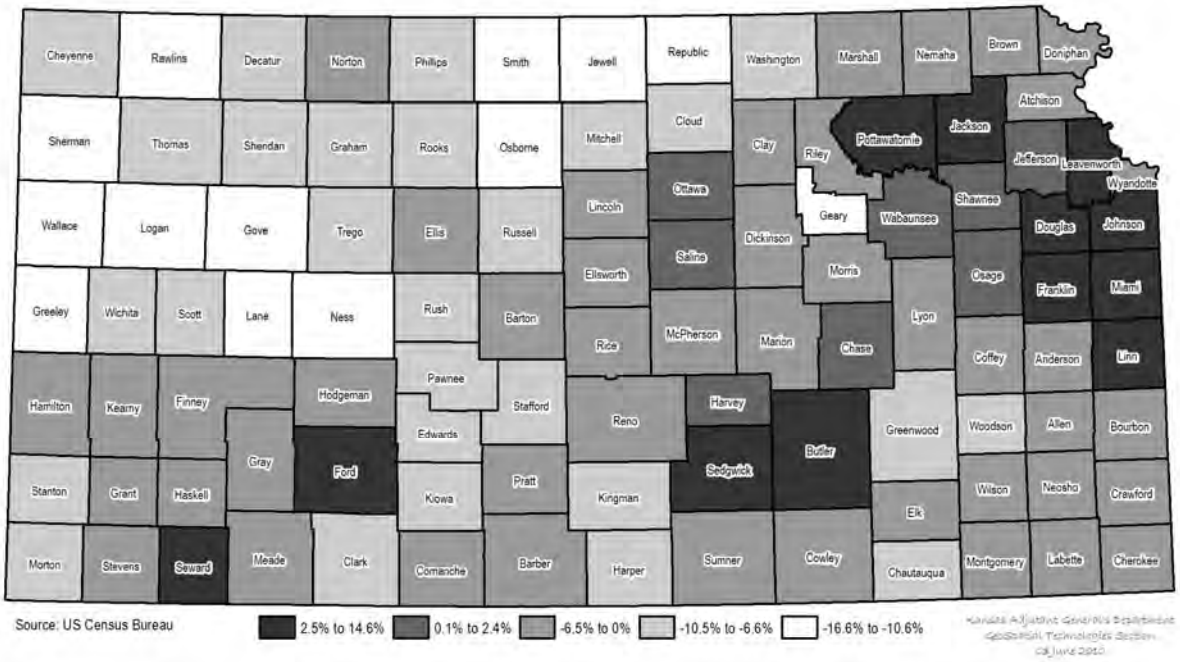


Table 3.5. Ten Counties with Greatest Estimated Population Losses (Numerical) 2000–2009

County	Population Loss 2000-2009
Wyandotte	-3,595
Sumner	-2,333
Cowley	-2,223
Montgomery	-1,866
Cherokee	-1,520
Reno	-1,363
Marion	-1,261
Allen	-1,067
Republic	-1,023
Labette	-955

Source: U.S. Census Bureau 2009, www.census.gov

Table 3.6. Ten Counties with Greatest Estimated Population Losses (Percent) 2000–2009

County	Population Loss (%) 2000-2009
Kiowa	-22.5
Wallace	-19.7
Lane	-19.1
Republic	-17.5
Greeley	-17.5
Jewell	-17.1
Gove	-16.9
Decatur	-16.1
Rawlins	-15.6
Wichita	-15.1

Source: U.S. Census Bureau 2009, www.census.gov

Table 3.7. Ten Smallest Counties Ranked by Population (Estimated) 2009

County	2009 Population
Greeley	1,275
Wallace	1,395
Lane	1,730
Comanche	1,898
Hodgeman	1,928
Clark	2,079
Wichita	2,117
Stanton	2,126
Sheridan	2,463
Rawlins	2,466

Source: U.S. Census Bureau 2009, www.census.gov

Interim population projections issued by the Kansas Division of the Budget suggest that Kansas' population will continue to grow, but percentages will drop, through 2025 (see Table 3.8).

Table 3.8. Interim Kansas Population Projections 2010–2025

Year	Projected Population	% Change
2010	2,818,880	+2.3
2015	2,880,017	+2.2
2020	2,936,670	+2.0
2025	2,988,382	+1.8

Source: Kansas Division of the Budget, http://budget.ks.gov/ecodemo.htm

Housing Units

Another indicator of growth is the number of housing units. The census defines a housing unit as: a house, an apartment, a mobile home or trailer, a group of rooms, or a single room that is occupied, or, if vacant, is intended for occupancy as separate living quarters. According to the U.S. Census Bureau, the number of estimated housing units in Kansas increased 8.4% (95,469 units) between 2000 and 2009. When comparing the number of housing units, the State of Kansas ranks 33rd amongst the 50 states. Johnson, Sedgwick, and Douglas counties top the list for numerical gains, and the 10 counties with the greatest rate of population growth (percent change) also had the greatest growth in housing units. In terms of housing units by number and percent, Table 3.9 and 3.10 list the counties that have grown the most. Johnson County has the highest population per county.

Table 3.9. Ten Counties with Greatest Estimated Housing Unit Gains (Numerical) 2000–2009

County	Housing Unit Gains 2000-2009
Johnson	35,370
Sedgwick	17,763
Douglas	6,068
Shawnee	5,580
Leavenworth	4,014
Riley	2,861
Butler	2,738
Miami	1,634
Crawford	1,112
Franklin	1,054

Source: US Census Bureau 2009, www.census.gov

Table 3.10. Ten Counties with Greatest Estimated Housing Unit Gains (Percent) 2000-2009

County	Housing Unit Gains (%) 2000-2009
Johnson	14.2
Douglas	11.7
Leavenworth	10.8
Miami	10.2
Butler	9.4
Pottawatomie	8.7
Franklin	7.8
Jefferson	7.5
Riley	6.9
Sedgwick	6.7

Source: U.S. Census Bureau 2009, www.census.gov

As illustrated in Table 3.11, the 10 most populous counties (Table 3.2) also have the most housing units.

Table 3.11. Top 10 Counties Ranked by Number of Housing Units (Estimated) 2009

County	Number of Housing Units, 2009
Johnson	216,983
Sedgwick	208,902
Shawnee	79,349
Wyandotte	67,870
Douglas	46,849
Leavenworth	28,415
Reno	28,228
Riley	26,590
Butler	25,914
Saline	23,636

Source: U.S. Census Bureau 2009, www.census.gov

Appendix C Population and Growth contains population and growth information for all Kansas counties updated with 2009 population estimates.

Density

Kansas has a surface land area of 81,815 square miles (2000 census), a population of 2,818,747 (2009 census estimate), and an estimated population density of 34.5 people per square mile. Based on the 2008 census estimates, Kansas ranked 40th in both population density and housing density among the 50 states. In 2008, 29 (28%) of Kansas' 105 counties had population densities of less than five people per square mile. Johnson and Wyandotte counties, with over 1,000 people per square mile, are by far the state's most densely populated counties. The same 10 counties ranked at the top in terms of both population density and housing density (see Table 3.12). Eight of these counties (excluding Crawford and Geary counties) also ranked among Kansas' top 10 most populous counties (see Table 3.2).

Table 3.12. Top 10 Counties Ranked by Population Density*, 2008

County	2008 Estimated Population Density	2008 Housing Density
Wyandotte	1,042.9	435.2
Johnson	946.1	380.9
Sedgwick	453.2	191.3
Shawnee	309.0	134.2
Douglas	218.8	88.1
Leavenworth	148.3	52.7
Riley	103.1	38.4
Saline	74.5	31.5
Geary	72.6	31.1
Crawford	64.5	29.0

Sources: U.S. Census Bureau 2001, 2006, 2007, www.census.gov

*Density is reported as people/housing units per square mile and is based on the square mileage of the counties in the 2000 census.
**Density Changes by percent have not been updated by the U.S. Census Bureau since 2008.

As should be expected, the percent change in population density largely tracks with the percent change in population growth (Table 3.3). The fastest growing counties are also seeing their population density increase more rapidly than the other counties (see Table 3.13) with the exception of Jackson, Linn, and Ford, which were replaced in the population density top 10 by Jefferson, Riley, and Sedgwick counties.

Table 3.13. Ten Counties with Greatest Estimated Population Density* Gains (Percent), 2000-2006

County	Population Density Gains** (%) 2000-2006
Johnson	14.1
Douglas	11.3
Leavenworth	10.6
Miami	9.6
Butler	8.6
Pottawatomie	8.1
Franklin	7.1
Jefferson	7.0
Riley	6.2
Sedgwick	5.8

Sources: U.S. Census Bureau 2001, 2006, 2007, www.census.gov

* Density is reported as people/housing units per square mile and is based on the square mileage of the counties in the 2000 census.
**Density Changes by percent have not been updated by the U.S. Census Bureau since 2008.

Table 3.14 Top 5 County Population Ranking State of Kansas 2006 Census Data)

County	Total Population
Johnson	516,731
Sedgwick	470,895
Shawnee	172,693
Wyandotte	155,509
Douglas	112,123

Appendix C Population and Growth contains population and growth information for all Kansas counties.

3.1.3 Social Vulnerability

A Social Vulnerability Index compiled by the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina measures the social vulnerability of U.S. counties to environmental hazards for the purpose of examining the differences in social vulnerability among counties. Based on national data sources, primarily the 2000 census, it synthesizes 42 socioeconomic and built environment variables that research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards (i.e., social vulnerability). Eleven composite factors were identified that differentiate counties according to their relative level of social vulnerability: personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race (African American and Asian), ethnicity (Hispanic and Native American), occupation, and infrastructure dependence.

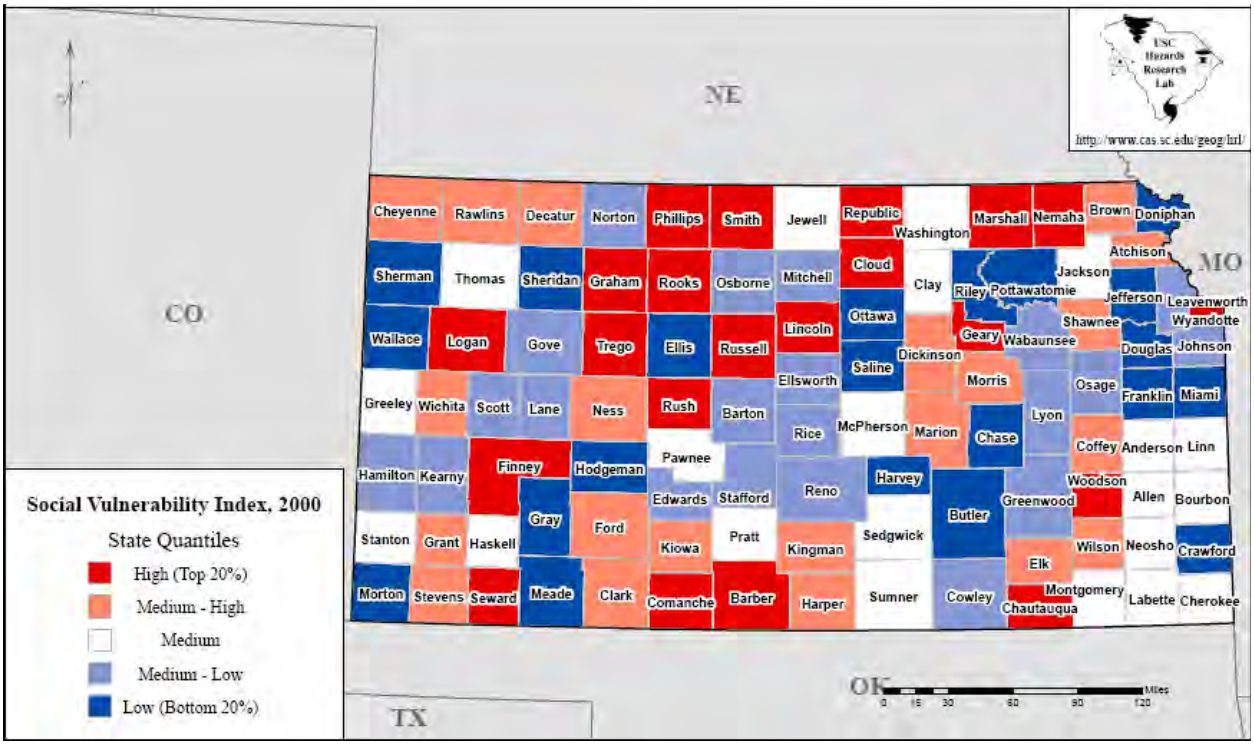
The index can be used by the state to help determine where social vulnerability and exposure to hazards overlaps and how and where mitigation resources might best be used. See Figure 3.3 for a map that illustrates Kansas' geographic variation in social vulnerability. According to the index, the following, listed in order, are Kansas' most vulnerable counties (i.e., they rank in the top 20% in the state—and the nation):

Smith	Geary
Russell	Trego
Comanche	Wyandotte*
Woodson	Rush
Republic	Chautauqua
Cloud	Logan
Rooks	Finney
Marshall	Barber
Phillips	Graham
Nemaha	Seward

*Wyandotte is one of the most populous counties in the state.

The counties of Lincoln, Elk, Kiowa, and Clark also rank in the top 20% in the nation (but not the state). To the extent possible and practicable, local jurisdictions should consider the factors that make up the social vulnerability index in their planning process. The state can use this information as an indication of where post-disaster recovery needs may be greatest. The state will consider further integration of this social vulnerability index in future updates of the risk assessment in this plan.

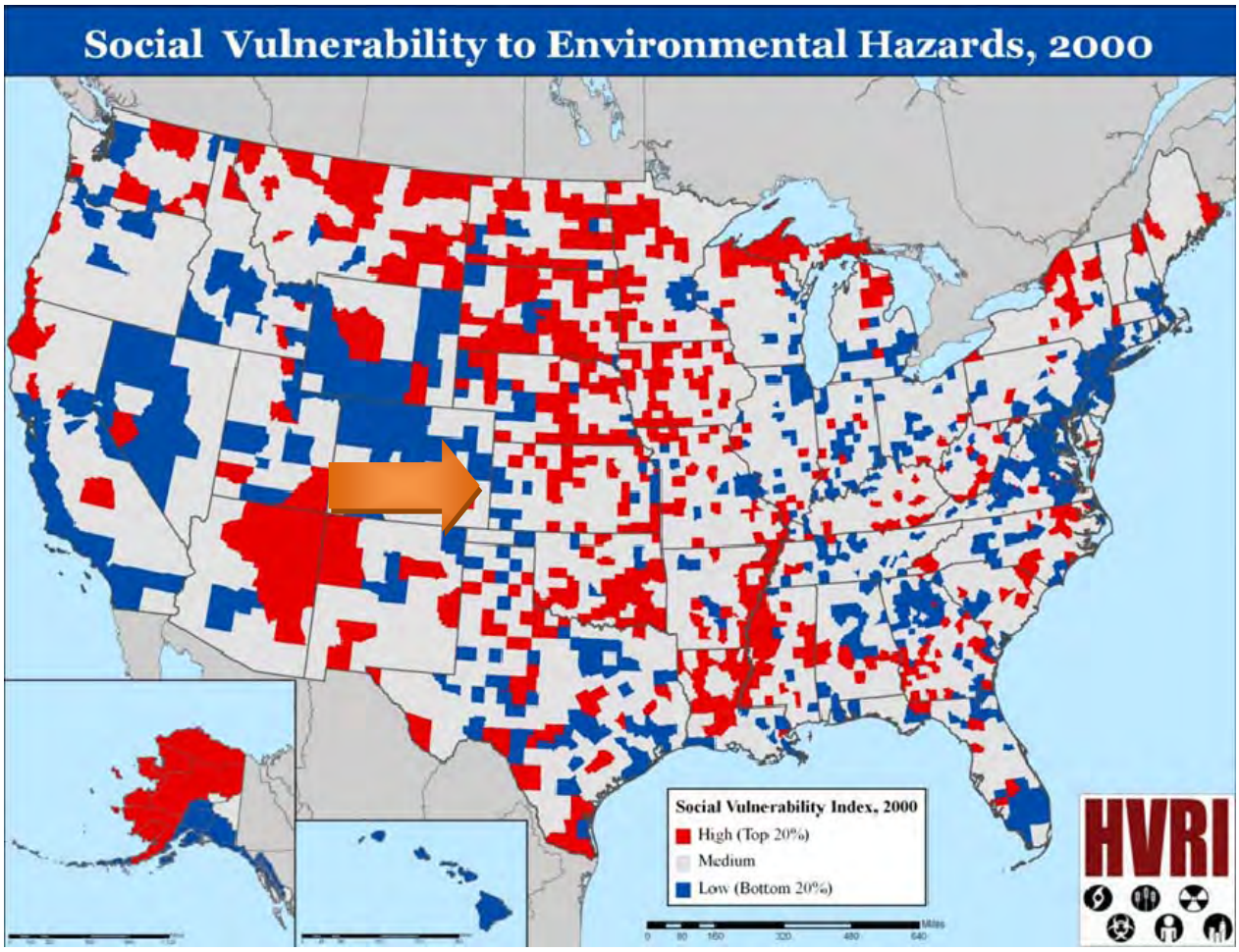
Figure 3.3. Social Vulnerability to Environmental Hazards, County Comparison within the State, 2000



Source: University of South Carolina, webra.cas.sc.edu/hvri/products/sovi.aspx

At the time of the 2010 revision, the Social Vulnerability Index 2000 is the most recent data.

The index synthesizes 32 socioeconomic variables, which the research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. The data were culled from national data sources, primarily those from the United States Census Bureau.



The data were compiled and processed by the Hazards and Vulnerability Research Institute at the University of South Carolina. The data was standardized and placed into a principal components analysis to reduce the initial set of variables into a smaller set of statistically optimized components. Adjustments were made to the components' cardinality (positive (+), negative (-), or absolute value (ll)) to ensure that positive component loadings were associated with increasing vulnerability, and negative component loadings with decreasing vulnerability. Once the cardinalities of the components were determined, the components were added together to determine the numerical social vulnerability score for each county. For SOVI™ 2000, there are nine significant components explaining 76% of the variance in the data. Among them are socioeconomic status, elderly and children, rural agriculture, housing density, African American female-headed households, gender, service industry employment, unemployed Native Americans, and infrastructure employment.

To visually compare the SOVI™ scores at a national level, they are mapped using quantiles. Scores in the top 20% of the United States are more vulnerable counties (red) and scores in the bottom 20% of the United States indicate the least vulnerable counties (blue).

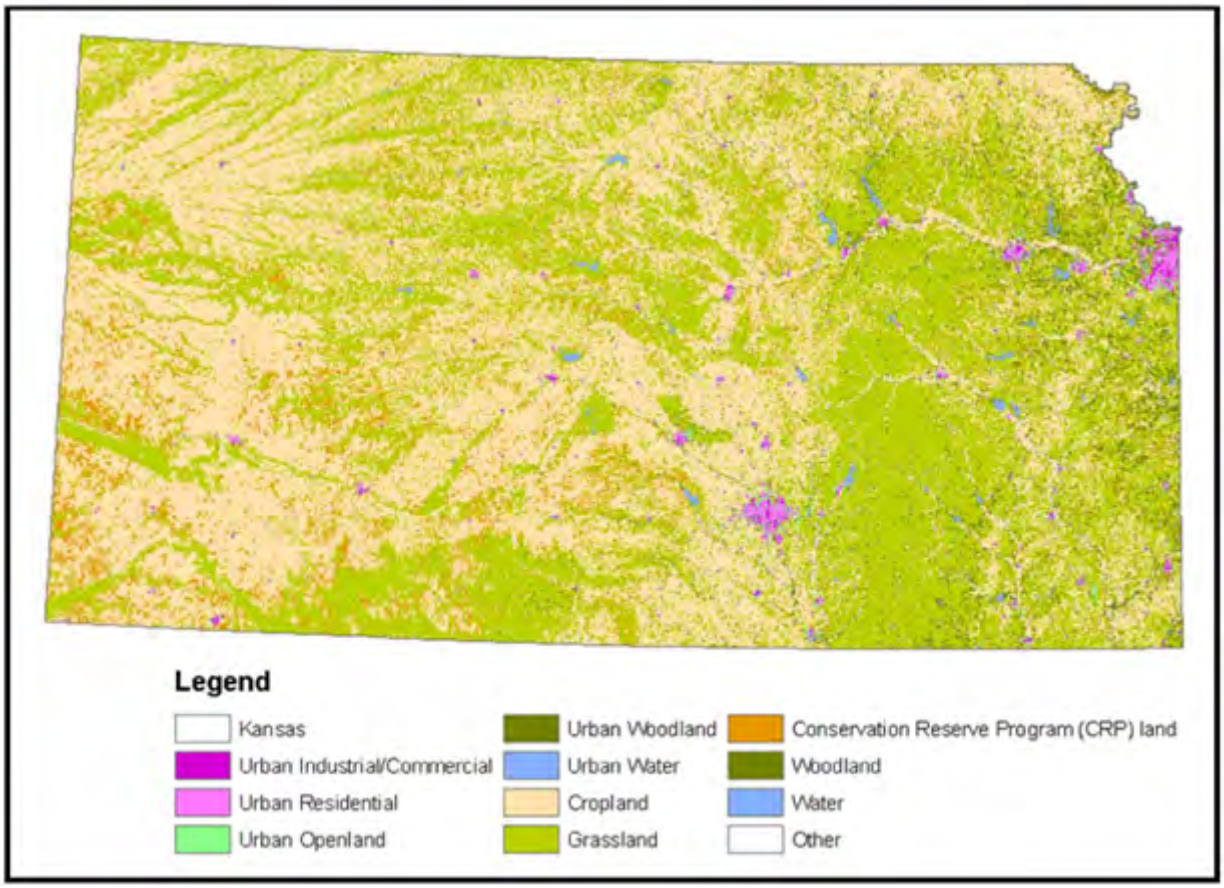
The initial SOVI™ methodology and results for 1990 were originally published in: S. L. Cutter, B. J. Boruff, and W. L. Shirley 2003. "Social Vulnerability to Environmental Hazards," Social Science Quarterly 84 (2): 242-261.

3.1.4 Land Use and Development Trends

General Land Use in Kansas

As indicated in Figure 3.4, the land cover in Kansas is predominantly agricultural. The central and western areas of the state are dominated by cropland and grassland. Overall, the state's land use is predominately rural. Urban and suburban uses of land are quite limited geographically and are confined primarily to the northeastern corner of the state in the Kansas City metropolitan area as well as around Topeka, and also in Wichita in south central Kansas.

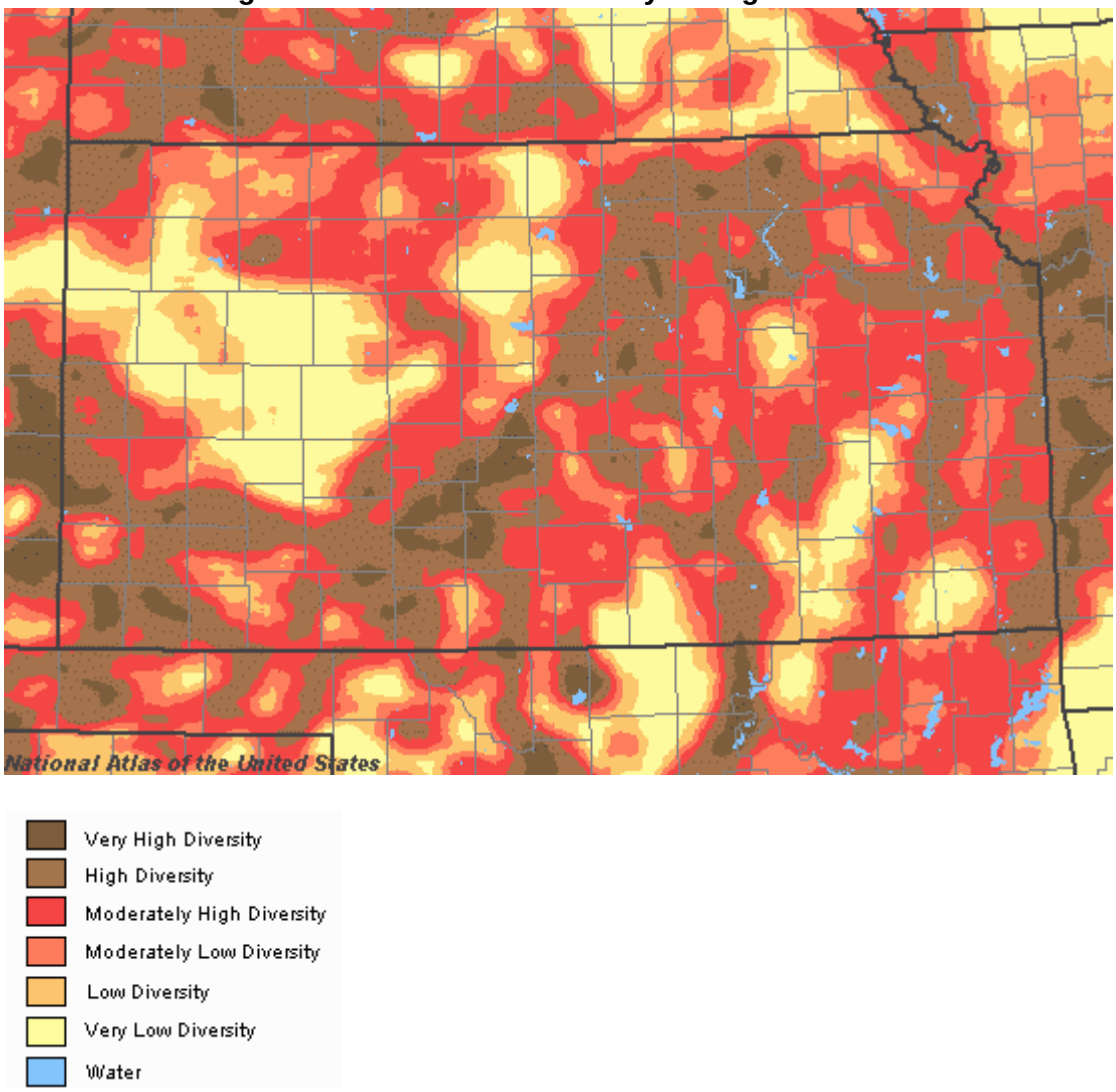
Figure 3.4. Kansas Land Use/Land Cover



Source: U.S. Geological Survey, National Atlas www.nationalatlas.gov, January 2010

Figure 3.5 shows that much of the state's land cover has been classified by the U.S. Geological Survey as having low to moderate diversity. For mitigation planning purposes, this would indicate that large areas of uniform or nearly uniform land cover, if vulnerable to the specific impacts of a disaster, such as agricultural infestation, would be relatively more at risk than areas with more diversified land cover.

Figure 3.5. Land Cover Diversity Rating in Kansas



Source: U.S. Geological Survey, National Atlas www.nationalatlas.gov, January 2010

One characteristic of local land use in Kansas, which must be considered in both state and local hazard mitigation planning, is how the land use patterns are changing at the community level. Identifying both the type and rate of change from existing land uses to future land uses, whether they are planned or unplanned, can help to identify the local jurisdictions most subject to development pressures and consequently help to focus the mitigation planning to minimize the vulnerability to future disasters of the newly constructed neighborhoods, facilities, and infrastructure. Data from local plans can be used to identify the jurisdictions where planned land uses are significantly different from existing land uses.

According to the Census of Agriculture estimates for 2009, more than 84% of Kansas land area is farmland (60.9% of farmland is cropland, 32.8% is pasture land, and 1.7% is woodland). This number was down from 90% in the 2005. One in five Kansans, rural and urban, work in jobs related to agriculture and food production. Agriculture and agribusiness are a major import to the Kansas economy.

According to the Kansas Department of Agriculture, Kansas farmers consistently produce more than any other state. Kansas also ranks first in grain sorghum produced, second in cropland and prime farmland, and third in land in farms and sunflowers produced. Kansas is also a leader in beef production. More than 22% of all beef originates from Kansas beef processing facilities. A disaster impacting the agricultural sector in Kansas could easily have ramifications nationwide.

Like other businesses, the size of farm enterprises will typically reflect the vulnerability of a farm to the impacts of disasters and is indicative of the availability of financial resources to recover in an event's aftermath. Sixty-seven percent of all Kansas farms are small, less than 500 acres, and the majority, 86%, are individual/family operated.

Figure 3.6 and Table 3.15 show the total farmland acreage by county; Figure 3.7 and Table 3.16 show the number of farms by county. The maps show that although there is more acreage of farmland in the western counties, there are more farms per county in the east. There are large parts of the state where agriculture is the mainstay of the local economy. Agriculture plays the largest role in local economies in central and western Kansas.

Figure 3.6. Total Kansas Farmland Acreage by County, 2009

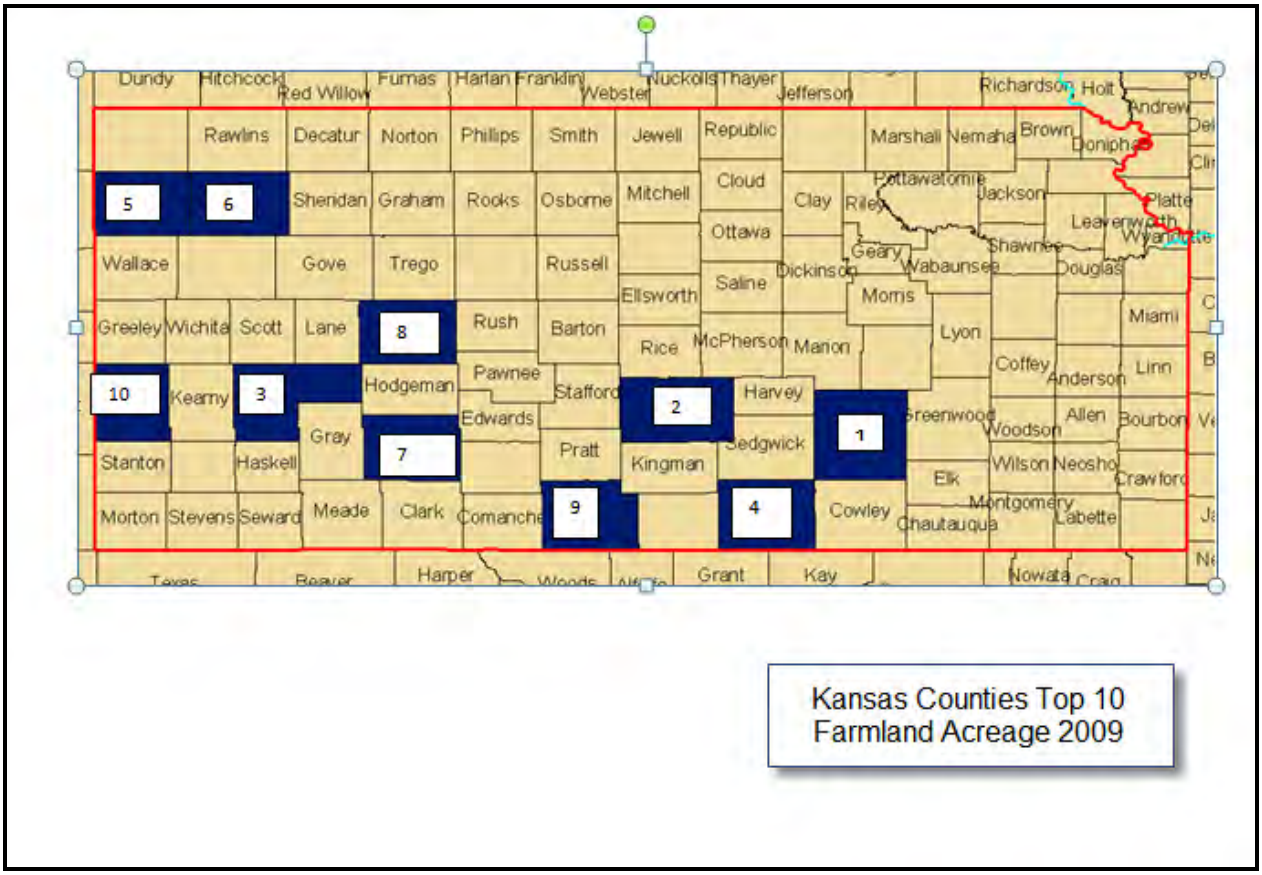


Table 3.15. Top 10 Kansas Counties Ranked by Farmland Acreage, 2009

County	Total Land In Farms, Acres
Butler	787,290
Reno	780,893
Finney	760,110
Sumner	709,865
Sherman	657,942
Thomas	657,471
Ford	634,240
Ness	619,948
Barber	611,493
Hamilton	610,864
Source: http://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/Annual_Statistical_Bulletin/ff2009.pdf	

Figure 3.7. Number of Farms by County, 2009

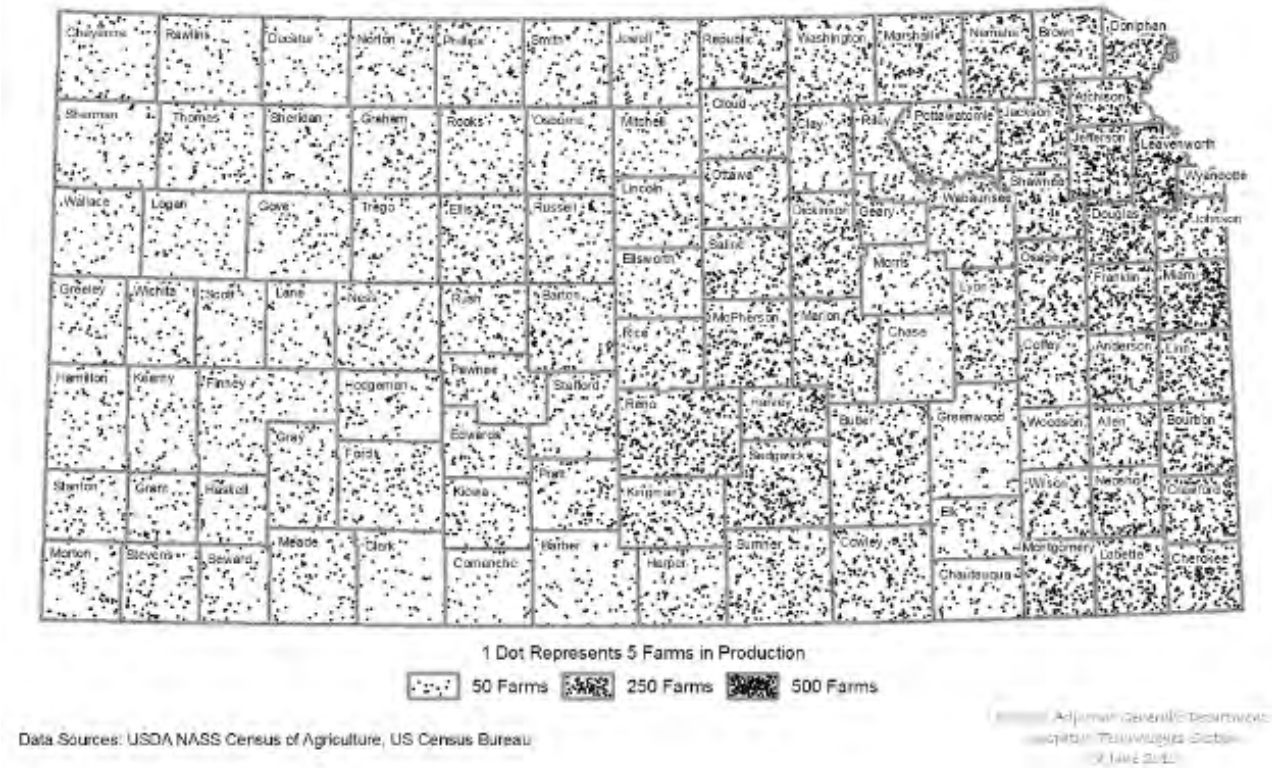


Table 3.16. Top 10 Counties Ranked by Number of Farms, 2009

County	Number of Farms
Reno	1,749
Miami	1,538
Butler	1,427
Sedgwick	1,419
Leavenworth	1,203
McPherson	1,142
Jefferson	1,137
Jackson	1,127
Sumner	1,099
Osage	1,092
Source: http://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/Annual_Statistical_Bulletin/ff2009.pdf	

As mentioned previously, the percent of land dedicated to farming in Kansas dropped between 2005 and 2009. Nevertheless, while some areas converted more land to farming, some farmland was converted to other uses.

Changes from rural to urban land use, and vice versa, will continue to alter the type and scale of the vulnerability of local jurisdictions to future disasters. Land use is dynamic, with regular shifts from one use to another. In agriculture, there are frequent shifts in the use of land among cropland, pastureland, rangeland, and woodland. Each time land use changes, it may affect its vulnerability (e.g., by increasing erosion potential or modifying hydrologic features). As local plans become available, especially those with significant land use changes, the state will review them to get a better understanding of the types of changes that are taking place and how they might affect the state's mitigation strategy.

3.1.5 Exposure of Built Environment

This section quantifies the buildings exposed to potential hazards, by county. Table 3.17 provides the value of the state's built environment, which in addition to the population information presented above, forms the basis of the vulnerability and risk assessment presented in this plan. Figure 3.8 illustrates the distribution of the value of this exposure across the state. This information was derived from inventory data associated with FEMA's loss estimation software HAZUS-MH MR 2 (May 2006). HAZUS-MH classifies building stock types into seven categories: residential, commercial, industrial, agriculture, religion, government, and education. Values associated with each of these categories reflect 2005 valuations, based on RSMeans (a supplier of construction cost information) replacement costs. According to the HAZUS-MH inventory, the total replacement value of buildings within the state is $154.7 billion. The exposure value of buildings is incorporated as a factor in vulnerability assessments for hailstorm, tornado, windstorm, and winter storm hazards that are profiled later in this plan. Information about state facilities is in Section 3.4 State Facilities: Vulnerability and Potential Losses.

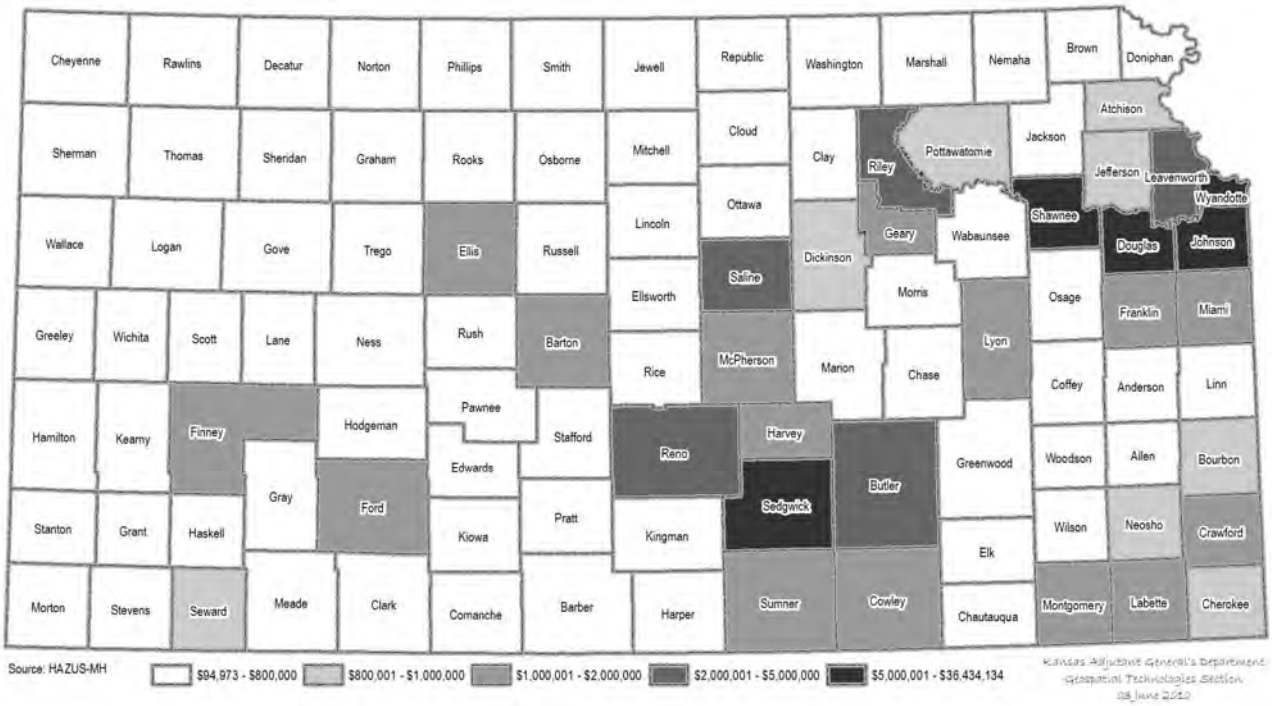
Table 3.17 Estimated Values for the Key Building Occupancies (Uses) for Kansas (2005 Valuations)

County	Residential ($000)	Commercial ($000)	Industrial ($000)	Agriculture ($000)	Religion ($000)	Government ($000)	Education ($000)	Total ($000)
Allen	637,885	87,981	14,204	768	7,215	3,491	14,688	766,232
Anderson	339,473	46,801	1,512	1,633	3,620	3,606	474	397,119
Atchison	830,750	89,533	40,715	4,818	5,760	1,433	439	973,448
Barber	246,549	36,011	6,951	4,994	3,174	495	3,554	301,728
Barton	1,041,236	199,854	96,423	13,890	17,189	5,070	4,865	1,378,527
Bourbon	694,762	85,255	57,830	5,235	8,643	358	1,639	853,722
Brown	447,054	89,818	14,283	18,439	8,550	3,256	4,744	586,144
Butler	2,559,240	201,441	23,547	6,797	21,457	9,859	8,629	2,830,970
Chase	135,821	8,637	1,550	930	932	0	1,749	149,619
Chautauqua	170,450	14,326	1,060	1,245	0	89	1,111	188,281
Cherokee	843,756	91,269	39,636	1,826	11,731	3,309	3,727	995,254
Cheyenne	119,918	26,396	1,770	8,710	2,457	382	340	159,973
Clark	123,036	18,024	1,260	3,010	1,630	122	804	147,886
Clay	385,379	46,087	6,381	1,804	7,461	2,936	788	450,836
Cloud	423,450	50,375	12,307	8,902	10,241	475	2,557	508,307
Coffey	429,621	48,941	3,955	3,374	3,422	6,703	2,562	498,578
Comanche	82,844	12,808	2,384	5,745	975	331	438	105,525
Cowley	1,473,314	187,552	66,350	7,941	11,313	4,255	6,599	1,757,324
Crawford	1,665,402	219,239	65,506	5,599	17,786	5,038	5,659	1,984,229
Decatur	146,626	23,074	1,637	9,727	571	2,707	153	184,495
Dickinson	828,075	101,877	12,273	4,276	8,221	211	6,754	961,687
Doniphan	351,133	54,096	14,821	10,022	3,488	788	6,711	441,059
Douglas	4,591,736	613,637	140,656	9,622	41,957	9,038	29,662	5,436,308
Edwards	148,959	18,960	4,549	6,258	1,073	0	2,257	182,056
Elk	137,031	9,082	2,313	2,159	953	1,658	1,355	154,551
Ellis	1,030,821	205,957	27,642	3,855	14,498	3,391	22,999	1,309,163
Ellsworth	304,133	30,433	3,709	2,517	3,853	1,048	2,923	348,616
Finney	1,166,395	231,597	36,737	12,718	13,955	6,503	14,337	1,482,242
Ford	1,095,610	225,045	34,615	7,374	15,588	5,418	8,462	1,392,112
Franklin	1,083,351	118,098	13,688	4,601	12,244	2,961	11,616	1,246,559
Geary	963,982	155,388	30,096	2,609	10,305	11,313	9,904	1,183,597
Gove	129,827	21,481	7,609	13,381	2,970	43	2,390	177,701
Graham	123,087	15,238	3,049	1,852	1,846	43	2,540	147,655
Grant	254,905	63,021	9,720	6,046	4,813	2,491	3,088	344,084
Gray	209,331	28,800	2,914	11,154	2,457	167	2,409	257,232
Greeley	82,093	10,098	2,558	6,027	1,103	2,507	2,890	107,276
Greenwood	347,001	82,307	9,975	5,259	1,409	199	5,297	451,447
Hamilton	113,978	20,471	2,730	11,330	4,165	633	3,599	156,906
Harper	277,507	41,617	13,047	6,470	3,161	1,371	2,221	345,394
Harvey	1,416,887	174,424	51,496	8,624	18,146	8,547	12,316	1,690,440
Haskell	147,299	31,133	6,272	4,794	1,745	365	404	192,012
Hodgeman	93,304	7,939	711	9,349	2,151	84	825	114,363
Jackson	563,335	50,239	3,277	2,695	2,520	1,822	6,139	630,027
Jefferson	850,431	45,930	3,353	2,540	3,955	2,462	4,734	913,405
Jewell	156,867	15,957	1,939	5,052	1,895	368	836	182,914

County	Residential ($000)	Commercial ($000)	Industrial ($000)	Agriculture ($000)	Religion ($000)	Government ($000)	Education ($000)	Total ($000)
Johnson	30,188,489	4,827,635	941,406	50,322	219,830	39,316	167,136	36,434,134
Kearny	144,045	32,073	2,027	5,270	2,159	449	1,135	187,158
Kingman	403,074	36,915	8,630	5,003	3,081	1,298	1,350	459,351
Kiowa	152,966	17,960	2,738	3,073	2,280	294	155	179,466
Labette	924,006	139,557	36,471	7,929	13,989	4,133	2,452	1,128,537
Lane	101,613	11,873	1,319	9,101	1,626	2,741	2,300	130,573
Leavenworth	3,590,200	408,622	48,353	6,544	21,739	26,589	31,597	4,133,644
Lincoln	142,386	18,320	1,502	7,373	2,144	1,526	265	173,516
Linn	466,240	35,173	7,998	5,387	5,808	2,213	1,905	524,724
Logan	131,789	24,674	1,531	5,456	1,255	585	0	165,290
Lyon	1,349,633	263,019	49,404	3,164	13,309	4,685	195,463	1,878,677
Marion	572,222	65,082	9,043	5,927	5,806	2,939	3,258	664,277
Marshall	467,885	62,805	6,606	6,980	4,137	810	5,026	554,249
McPherson	1,311,527	191,178	48,739	4,695	17,620	2,328	7,374	1,583,461
Meade	197,166	19,930	3,894	7,766	568	1,345	3,195	233,864
Miami	1,496,071	119,989	15,165	3,618	7,294	3,389	10,115	1,655,641
Mitchell	308,914	57,288	6,829	9,707	3,715	3,694	5,953	396,100
Montgomery	1,509,166	252,633	83,691	11,204	19,064	5,534	7,614	1,888,906
Morris	264,562	32,642	9,597	15,325	4,128	690	1,141	328,085
Morton	148,840	28,163	4,275	5,510	3,191	1,567	1,693	193,239
Nemaha	456,204	81,341	32,575	23,527	2,622	1,455	3,720	601,444
Neosho	702,453	100,401	29,572	10,373	5,868	3,223	4,808	856,698
Ness	136,154	29,279	7,325	6,489	3,691	320	2,774	186,032
Norton	225,970	49,489	16,528	7,587	2,947	2,840	367	305,728
Osage	727,204	53,127	2,484	3,168	5,707	2,850	4,792	799,332
Osborne	172,315	35,420	18,071	6,094	1,725	909	1,847	236,381
Ottawa	275,992	21,785	8,168	3,153	2,349	358	559	312,364
Pawnee	314,681	32,040	1,844	7,367	4,121	2,775	1,100	363,928
Phillips	278,691	37,265	2,108	5,370	3,303	2,431	861	330,029
Pottawatomie	752,561	105,157	18,209	11,878	10,295	3,005	10,005	911,110
Pratt	443,239	106,520	16,548	8,073	4,610	2,653	26,575	608,218
Rawlins	125,057	21,720	1,865	7,259	2,121	346	1,036	159,404
Reno	2,654,134	461,801	91,463	12,479	31,838	7,225	14,918	3,273,858
Republic	267,338	28,748	2,028	12,562	4,151	671	1,818	317,316
Rice	440,652	56,325	22,571	4,125	4,282	1,161	2,871	531,987
Riley	2,682,722	379,616	23,137	17,147	39,128	20,404	89,928	3,252,082
Rooks	195,196	31,732	13,120	3,588	3,773	189	484	248,082
Rush	126,697	19,536	4,576	2,209	1,104	395	1,452	155,969
Russell	299,262	44,000	8,122	3,492	3,191	706	2,147	360,920
Saline	2,197,408	421,027	111,861	6,404	33,525	3,443	20,085	2,793,753
Scott	202,531	39,479	4,782	13,289	4,028	1,303	1,948	267,360
Sedgwick	20,664,216	3,452,698	632,176	29,078	196,221	32,515	95,756	25,102,660
Seward	656,004	165,864	20,343	4,106	9,223	547	11,444	867,531
Shawnee	7,926,574	1,323,334	143,112	10,195	67,490	66,120	23,930	9,560,755
Sheridan	126,164	26,143	1,963	10,353	2,895	636	280	168,434
Sherman	291,191	63,888	2,892	5,263	3,296	843	1,293	368,666
Smith	164,760	22,752	12,204	9,973	3,687	260	273	213,909

County	Residential ($000)	Commercial ($000)	Industrial ($000)	Agriculture ($000)	Religion ($000)	Government ($000)	Education ($000)	Total ($000)
Stafford	191,912	22,092	1,235	6,517	3,262	144	260	225,422
Stanton	94,157	15,813	1,975	7,758	978	192	434	121,307
Stevens	202,558	24,182	5,660	4,362	2,824	1,565	2,760	243,911
Sumner	1,090,144	113,869	57,134	3,792	7,054	1,689	9,186	1,282,868
Thomas	374,194	68,582	4,757	6,065	5,843	877	5,586	465,904
Trego	134,476	15,697	2,350	2,465	2,856	317	0	158,161
Wabaunsee	330,851	19,354	1,855	2,392	3,023	509	3,820	361,804
Wallace	72,820	13,335	225	5,115	1,220	0	2,258	94,973
Washington	234,960	24,190	3,886	4,845	3,038	458	2,602	273,979
Wichita	96,718	14,726	214	7,235	2,375	1,098	266	122,632
Wilson	384,448	29,320	21,893	3,600	4,206	3,302	3,467	450,236
Woodson	146,933	11,357	3,623	1,554	170	962	5,353	169,952
Wyandotte	7,545,358	1,545,085	306,218	10,924	97,660	14,115	68,915	9,588,275
Source: HAZUS-MH MR2								

Figure 3.8. Building Exposure



3.2 Hazard Identification

IFR REQUIREMENT *201.4(c)(2)(i):*	[The State risk assessment shall include an] overview of the type … of all natural hazards that can affect the State.
Explanation:	A State hazard mitigation plan will only be effective if it accounts for all sources of risk. The intent of this requirement is to insure that all hazards potentially affecting the State are identified. During the State's planning process (as evaluated in the Planning Process section of this document), it may be determined that some of these hazard types do not pose a significant enough threat to justify further study or the identification of corresponding mitigation actions. However, the mitigation plan ***should*** clearly document that a thorough and comprehensive identification of hazards was performed by the State, including the fact that certain hazards were deemed not to be significant enough to warrant further study, to receive a satisfactory score for this requirement. This section ***should*** include a description of how the State collected the information to identify these hazards, including the sources of information. This process *should* also include incorporating the results of local level mitigation planning efforts to identify hazards as that information becomes available.
Update	The updated plan **must** address any newly identified hazards or hazards that have been determined to pose a more significant threat than was apparent when the previously approved plan was prepared. If improved descriptions of hazards identified in the previous plan are available, they **must** be incorporated into this section.

3.2.1 State Plan Hazard Identification

This section identifies the natural, technological, and manmade hazards that pose a threat to Kansas and defines the current priority for attention assigned to each by the KHMT based on the profiles and vulnerability assessments. In presenting these decisions, it is first important to recognize how the decisions were formulated.

As an interagency state level committee, the KHMT represents a broad range of expertise and interest related to hazard mitigation. When considering the human, economic, and environmental impacts of disasters and emergencies, the origin of the event is not as significant as its effect. Therefore, the KHMT chose to address natural, technological, and manmade hazards, recognizing that mitigation efforts for one may be beneficial for the others. In its initial process to identify and categorize the hazards threatening Kansas, the KHMT worked as a single group, exchanging information and viewpoints during a facilitated consensus process to reach decisions on the hazards to be addressed and the priority for each. The intent of the analysis was an objective assessment of the vulnerability of the State of Kansas to each hazard under discussion.

In deciding to discuss hazards as individual hazards, it must be emphasized that this division is somewhat artificial and used only to facilitate analyses. That is, one hazard event can result in another different hazard event. For example, drought can lead to wildfire, soil erosion, and dust; severe winter storms and high wind events often cause utility and infrastructure failures. Similarly, some hazards can occur simultaneously, as the result of the same storm (e.g., tornado, hailstorm, lightning, flood, and windstorm).

Methodology

Based on the experience of the representatives of the participating agencies of the KHMT, the hazards identified in the previous plans have been revisited, reevaluated, reorganized, and reprioritized to reflect the hazards environment in Kansas at the time of the 2010 plan update. Twenty-two hazards have been identified as threatening to all or significant portions of the State of Kansas, and pose a sufficient level of human, economic, and/or environmental risk to the communities of the state that they warrant incorporation into the Kansas Hazard Mitigation Plan.

Listed alphabetically, these hazards are:

Agricultural Infestation	Hailstorm	Soil Erosion and Dust
Dam and Levee Failure	Hazardous Materials	Terrorism/Agri-Terrorism/Civil Disorder
Drought	Land Subsidence	Tornado
Earthquake	Landslide	Utility/Infrastructure Failure
Expansive Soils	Lightning	Wildfire
Extreme Temperatures	Major Disease Outbreak	Windstorm
Flood	Radiological	Winter Storm
Fog		

The following natural hazards identified by FEMA are not included in this analysis because they do not threaten Kansas: avalanche, coastal erosion, coastal storm, hurricane, tsunami, and volcano.

In the previous plan and in the 2010 plan, the state used the methodology from the MitigationPlan.com planning tool to prioritize the 22 hazards. This prioritization was based on a calculated priority risk index (CPRI) that considered four elements of risk: probability, magnitude/severity, warning time, and duration. Table 3.18 defines the levels for each element of risk.

For the 2010 Mitigation Plan revision, the committee determined that no previously identified hazards would be excluded from the new plan. Hazards were identified that needed to be added. These hazards are identified in the Major Disease Outbreak section. Specific input from the Kansas Department of Health and Environment, Division of Health was added to the mitigation plan and reviewed in pre-scheduled public mitigation planning meetings.

Table 3.18. Calculated Priority Risk Index (CPRI) Element Definitions

Element/Level	Characteristics
Probability	
4 - Highly Likely	Event is probable within the calendar year Event has up to 1 in 1 year chance of occurring (1/1=100%) History of events is greater than 33% likely per year Event is "Highly Likely" to occur
3 - Likely	Event is probable within the next three years Event has up to 1 in 3 years chance of occurring (1/3=33%) History of events is greater than 20% but less than or equal to 33% likely per year Event is "Likely" to occur
2 - Possible	Event is probable within the next five years Event has up to 1 in 5 years chance of occurring (1/5=20%) History of events is greater than 10% but less than or equal to 20% likely per year Event could "Possibly" occur
1 - Unlikely	Event is possible within the next 10 years Event has up to 1 in 10 years chance of occurring (1/10=10%) History of events is less than or equal to 10% likely per year Event is "Unlikely" but is possible of occurring
Magnitude / Severity**	
4 - Catastrophic	Multiple deaths Complete shutdown of facilities for 30 or more days More than 50% of property is severely damaged
3 - Critical	Injuries and/or illnesses result in permanent disability Complete shutdown of critical facilities for at least two weeks 25–50% of property is severely damaged
2 - Limited	Injuries and/or illnesses do not result in permanent disability Complete shutdown of critical facilities for more than one week 10–25% of property is severely damaged
1 - Negligible	Injuries and/or illnesses are treatable with first aid Minor quality of life lost Shutdown of critical facilities and services for 24 hours or less Less than 10% of property is severely damaged
Warning Time	
4	Less Than 6 Hours
3	6-12 Hours
2	12-24 Hours
1	24+ Hours
Duration	
4	More Than 1 Week
3	Less Than 1 Week
2	Less Than 1 Day
1	Less Than 6 Hours

* Based on history, using the definitions given, the likelihood of future events is quantified.
** According to the severity associated with past events or the probable worst case scenario possible in the state.

Using the levels described in Table 3.18, the following formula was used to determine each hazard's CPRI.

(Probability x .45)+ (Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10)=CPRI

Based on their CPRI, the hazards were separated into three categories of planning significance: High (3.0-4.0), Moderate (2.0-2.95), and Low (1.1-1.95) The CPRI does have some limitations as the number of fatalities and injuries are not a calculated element, and thus cannot alter the rating.

These terms relate to the level of planning analysis to be given to the particular hazard in the risk assessment process and are not meant to suggest that a hazard would have only limited impact. In order to focus on the most critical hazards, those assigned a level of significant or moderate were given more extensive attention in the remainder of this analysis (e.g., quantitative analysis or loss estimation), while those with a low planning significance were addressed in more general or qualitative ways.

All listed hazards, and their corresponding CPRI ranking methodology was reviewed and verified by all members of the KHMT during recorded mitigation meetings. The CPRI index was approved for the 2010 State mitigation planning update during the 2/24/2010 KHMT meeting (detailed in Table 2.1 pg 2.5).

In addition to CPRI, the mitigation plan also incorporated hazard rankings from all approved Kansas Local Mitigation Plans into its Risk Assessment strategy.

The hazard ranking was based on the CPRI for the state as a whole. When examining various regions of the state, the same ranking does not always apply. Table 3.19 indicates the ranking established by the state using the method described above.

Table 3.19. Hazard Ranking and Planning Consideration

Hazard	Calculated Priority Risk Index	Probability	Planning Significance
Flood	3.45	Highly Likely	**High**
Tornado	3.40	Highly Likely	**High**
Windstorm	3.35	Highly Likely	**High**
Winter Storm	3.30	Highly Likely	**High**
Major Disease Outbreak	3.25	Highly Likely	**High**
Wildfire	3.20	Highly Likely	**High**
Hailstorm	2.95	Highly Likely	**Moderate**
Agricultural Infestation	2.95	Highly Likely	**Moderate**
Hazardous Materials	2.90	Highly Likely	**Moderate**
Utility/Infrastructure Failure	2.85	Likely	**Moderate**
Terrorism/Agri-Terrorism/Civil Disorder	2.65	Unlikely	**Moderate**
Land Subsidence	2.65	Highly Likely	**Moderate**
Expansive Soils	2.65	Highly Likely	**Moderate**
Lightning	2.50	Highly Likely	**Moderate**
Extreme Temperatures	2.40	Likely	**Moderate**
Drought	2.35	Possible	**Moderate**
Dam and Levee Failure	2.35	Unlikely	**Moderate**

Hazard	Calculated Priority Risk Index	Probability	Planning Significance
Landslide	2.20	Likely	Moderate
Radiological	1.95	Unlikely	Low
Soil Erosion and Dust	1.75	Possible	Low
Earthquake	1.75	Unlikely	Low
Fog	1.60	Possible	Low

A hazard identification and ranking worksheet is included as Appendix E Hazard Identification and contains all the calculations and formulas used.

Challenges to prioritizing the hazards included the following:

- There is a wide variation in information and data currently available regarding different categories of hazards to allow direct, quantitative comparison.
- While Kansas has experienced many different types of hazard events, significant events in some of the defined hazard categories have not occurred recently or within the period of recorded history. Nevertheless, the risk they pose to Kansas is high enough that these types of events must be considered.
- Variations in hazard vulnerability across the state of Kansas are highlighted in each Hazard Location or Local Plan Integration Section in Chapter 3

Overall there were only minor changes to how the hazards ranked in significance between 2007 and 2010. In 2010, with the inclusion of the new information, Major Disease Outbreak, which was previously ranked twelfth, jumped up to the fifth highest priority rating. Flooding was first, tornadoes second; windstorm and winter storm, ranked third and fourth. Earthquake and fog remained the lowest ranked hazards for the 2010 update.

Beneficial to the identification process was information about historical hazard events in Kansas. This information came largely from state and federal agencies. One of the most useful resources was FEMA's list of presidential disaster declarations for the State of Kansas. This list, which also indicates the increased number of disaster declarations in recent years, is presented in Table 3.20.

Table 3.20. Kansas Presidential Declarations May 1955–March 2010

Declaration Number	Declaration Date*	Disaster Description	Counties Involved	Constant 2006 $**
Major Disaster Declarations				
1885	03/09/2010	Severe Winter Storms and Snowstorm	Allen, Anderson, Atchison, Bourbon, Brown, Butler, Cherokee, Cheyenne, Clay, Cowley, Crawford, Decatur, Doniphan, Elk, Franklin, Gove, Graham, Greenwood, Jackson, Jefferson, Jewell, Labette, Linn, Logan, Lyon, Marshall, Miami, Morris, Nemaha, Neosho, Norton, Osage, Phillips, Pottawatomie, Rawlins, Republic, Riley, Shawnee, Sheridan, Wabaunsee, Wallace, Washington, Wilson, Woodson, Wyandotte	
1868	12/23/2009	Severe Winter Storm	Marshall, Republic, and Washington	

Declaration Number	Declaration Date*	Disaster Description	Counties Involved	Constant 2006 $**
1860	09/30/2009	Severe Storms and Flooding	Anderson, Bourbon, Franklin, Linn, and Sedgwick	
1849	06/25/2009	Severe Storms, Flooding, Straight-line Winds, and Tornadoes	Anderson, Barber, Bourbon, Butler, Chase, Cherokee, Coffey, Cowley, Crawford, Elk, Finney, Greenwood, Harper, Harvey, Kingman, Labette, Linn, Lyon, Marion, Marshall, Montgomery, Morris, Neosho, Reno, Rice, Sumner, Wabaunsee, and Wilson	
1848	06/24/2009 (3/26-29/2009)	Severe Winter Storm and Record and Near Record Snow	Butler, Chase, Chautauqua, Coffey, Cowley, Dickinson, Elk, Grant, Greenwood, Harvey, Lyon, Marion, Morris, Sumner, and Woodson	
1808	10/31/2008	Severe Storms, Flooding, and Tornadoes	Anderson, Butler, Chase, Cowley, Greenwood, Harper, Harvey, Russell, and Sumner	
1776	07/09/2008	Severe Storms, Flooding, and Tornadoes	Barber, Barton, Bourbon, Brown, Butler, Chautauqua, Cherokee, Clark, Clay, Comanche, Cowley, Crawford, Decatur, Dickinson, Edwards, Elk, Ellis, Ellsworth, Franklin, Gove, Graham, Harper, Haskell, Hodgeman, Jackson, Jewell, Kingman, Kiowa, Lane, Linn, Logan, Mitchell, Montgomery, Ness, Norton, Osborne, Pawnee, Phillips, Pratt, Reno, Republic, Riley, Rooks, Rush, Saline, Seward, Sheridan, Smith, Stafford, Sumner, Thomas, Trego, Wallace and Wilson	
1741	02/01/2008	Severe Winter Storms	Atchison, Barber, Barton, Brown, Butler, Chase, Cherokee, Clark, Clay, Cloud, Comanche, Crawford, Dickinson, Doniphan, Edwards, Ellis, Ellsworth, Ford, Geary, Graham, Gove, Harvey, Hodgeman, Jackson, Jefferson, Jewell, Kingman, Kiowa, Labette, Leavenworth, Lincoln, Logan, Lyon, Marion, Marshall, McPherson, Miami, Mitchell, Morris, Nemaha, Osage, Osborne, Ottawa, Pawnee, Phillips, Pottawatomie, Pratt, Reno, Republic, Rice, Riley, Rooks, Rush, Russell, Saline, Sedgwick, Shawnee, Sheridan, Smith, Stafford, Thomas, Wabaunsee, Wallace, Washington, and Woodson.	
1711	7/2/2007 (6/26-30/2007)	Severe Storms and Flooding	Allen, Anderson, Bourbon, Butler, Chautauqua, Cherokee, Coffey, Cowley, Crawford, Edwards, Elk, Franklin, Greenwood, Harper, Labette, Linn, Miami, Montgomery, Neosho, Osage, Pawnee, Wilson, Woodson	n/a
1699	5/6/2007 (5/4/2007)	Severe Storms, Tornadoes, and Flooding	Barton, Brown, Chase, Cherokee, Clay, Cloud, Comanche, Cowley, Dickinson, Doniphan, Douglas, Edwards, Ellsworth, Harper, Harvey, Jackson, Kingman, Kiowa, Leavenworth, Lincoln, Lyon, Marshall, McPherson, Morris, Nemaha, Osage, Osborne, Ottawa, Pawnee, Phillips, Pottawatomie, Pratt, Reno, Rice, Riley, Saline, Shawnee, Smith, Stafford, Sumner, Wabaunsee, Washington	65,979,498
1675	1/7/2007 (12/28-30/2006)	Severe Winter Storm	Cheyenne, Clark, Comanche, Decatur, Edwards, Ellis, Finney, Ford, Gove, Graham, Grant, Gray, Greeley, Hamilton, Haskell, Hodgeman, Jewell, Kearny, Kiowa, Lane, Logan, Meade, Morton, Ness, Norton, Osborne,	371,000,000

Declaration Number	Declaration Date*	Disaster Description	Counties Involved	Constant 2006 $**
			Pawnee, Phillips, Rawlins, Rooks, Rush, Russell, Scott, Seward, Sheridan, Sherman, Smith, Stafford, Stanton, Stevens, Thomas, Trego, Wallace, Wichita	
1638	4/14/2006 (3/12-13/2006)	Severe Storms, Tornadoes, and Straight-Line Winds	Douglas, Wyandotte	n/a
1626	1/26/2006 (11/27-28/2005)	Severe Winter Storm	Cheyenne, Decatur, Edwards, Gove, Graham, Hodgeman, Ness, Norton, Pawnee, Phillips, Rawlins, Rooks, Rush, Sheridan, Sherman, Thomas, Trego	32,700,820
1615	11/21/2005 (10/1-2/2005)	Severe Storms and Flooding	Atchison, Jackson, Jefferson, Leavenworth, Shawnee	7,310,228
1600	8/23/2005 (6/30-7/1/2005)	Severe Storms and Flooding	Cherokee, Crawford, Neosho	3,258,794
1579	2/8/2005 (1/4-6/2005)	Severe Winter Storm, Heavy Rains, and Flooding	Anderson, Atchison, Barber, Brown, Butler, Chase, Chautauqua, Clark, Coffey, Comanche, Cowley, Crawford, Douglas, Elk, Franklin, Greenwood, Harper, Harvey, Jackson, Jefferson, Kingman, Kiowa, Leavenworth, Lyon, Marion, McPherson, Morris, Osage, Pratt, Reno, Rice, Sedgwick, Shawnee, Sumner, Wabaunsee, Woodson, Wyandotte	84,447,071
1562	09/30/2004 (8/27-30/2004)	Severe Storms, Flooding, and Tornadoes	Douglas, Wyandotte	2,093,550
1535	8/3/2004 (6/12-7/25/2004)	Severe Storms, Flooding, and Tornadoes	Barton, Butler, Cherokee, Decatur, Ellis, Geary, Graham, Jewell, Labette, Lyon, Marion, Mitchell, Morris, Ness, Osborne, Pawnee, Phillips, Rooks, Rush, Russell, Shawnee, Sheridan, Smith, Thomas, Trego, Wabaunsee, Wallace, Woodson, Wyandotte	12,376,235
1462	5/6/2003 (5/4-30/2003)	Severe Storms, Tornadoes, and Flooding	Allen, Anderson, Cherokee, Crawford, Douglas, Haskell, Labette, Leavenworth, Meade, Miami, Neosho, Osage, Seward, Woodson, Wyandotte	15,503,728
1402	2/6/2002 (1/29-2/15/2002)	Ice Storm	Allen, Anderson, Barber, Bourbon, Butler, Chautauqua, Cherokee, Coffey, Comanche, Cowley, Crawford, Douglas, Elk, Franklin, Greenwood, Harper, Jefferson, Johnson, Kingman, Kiowa, Labette, Leavenworth, Linn, Lyon, Miami, Montgomery, Neosho, Osage, Pratt, Sedgwick, Shawnee, Sumner, Wilson, Woodson, Wyandotte	65,347,119
1366	4/27/2001 (4/21/2001)	Severe Storms and Tornado	Barton	5,303,272
1327	5/3/2000 (4/19/2000)	Severe Storms and Tornadoes	Crawford, Labette, Neosho	2,939,476
1273	5/4/1999 (5/3/1999)	Tornadoes and Severe Storms	Reno, Sedgwick, Sumner	10,883,676
1258	11/5/1998 (10/30-11/15/1998)	Severe Storms and Flooding	Butler, Chase, Coffey, Cowley, Douglas, Franklin, Greenwood, Harper, Harvey, Johnson, Leavenworth, Lyon, Marion, Neosho, Saline, Sedgwick, Sumner, Wilson, Woodson, Wyandotte	20,179,021
1254	10/14/1998 (10/1-	Severe Storms, Flooding, and	Bourbon, Cherokee, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth,	11,814,290

Declaration Number	Declaration Date*	Disaster Description	Counties Involved	Constant 2006 $**
	10/8/1998)	Tornadoes	Linn, Seward, Wabaunsee, Wyandotte	
1000	7/22/1993	Flooding, Severe Storms	Atchison, Barton, Brown, Chase, Cherokee, Clay, Cloud, Crawford, Dickinson, Doniphan, Douglas, Edwards, Ellis, Ellsworth, Geary, Graham, Harvey, Hodgeman, Jackson, Jefferson, Jewell, Johnson, Lane, Leavenworth, Lincoln, Lyon, Marion, Marshall, McPherson, Mitchell, Morris, Nemaha, Ness, Osage, Osborne, Ottawa, Pawnee, Pottawatomie, Reno, Republic, Rice, Riley, Rooks, Rush, Russell, Saline, Sedgwick, Shawnee, Sheridan, Smith, Stafford, Sumner, Thomas, Trego, Wabaunsee, Washington, Wyandotte	137,038,990
903	4/29/1991	Severe Storm, Tornado	Butler, Cowley, Jefferson, Sedgwick, Wabaunsee, Washington	7,132,333
780	10/22/1986	Severe Storms, Flooding	Allen, Bourbon, Chautauqua, Cherokee, Cowley, Elk, Labette, Montgomery, Neosho, Wilson	4,214,319
714	6/22/1984	Severe Storms, Tornadoes, Flooding	Atchison, Brown, Doniphan, Jackson, Nemaha, Pottawatomie	9,565,631
663	6/28/1982	Severe Storms, Flooding	Jackson, Shawnee	1,643,741
644	7/18/1981	Severe Storms, Flooding, Tornadoes	Barton, Douglas	1,451,391
588	6/15/1979	Severe Storms, Flooding	Butler, Cowley	2,896,578
539	9/20/1977	Severe Storms, Flooding	Atchison, Brown, Doniphan, Jackson, Jefferson, Johnson, Leavenworth, Nemaha, Shawnee, Wyandotte	13,052,810
514	7/13/1976	Severe Storms, High Winds, Flooding	Butler, Cherokee, Crawford, Cowley, Elk, Greenwood, Labette, Neosho, Montgomery, Wilson	6,233,574
442	6/10/1974	Severe Storms, Flooding	Lyon	1,198,472
403	9/28/1973	Severe Storms, Tornadoes, Flooding	Atchison, Barber, Barton, Brown, Butler, Chase, Clay, Cloud, Coffey, Comanche, Cowley, Dickinson, Doniphan, Douglas, Edwards, Ellsworth, Franklin, Geary, Greenwood, Harper, Harvey, Jackson, Jefferson, Kingman, Kiowa, Leavenworth, Lincoln, Linn, Lyon, Marion, Marshall, McPherson, Miami, Morris, Nemaha, Osage, Ottawa, Pawnee, Pottawatomie, Pratt, Reno, Republic, Rice, Riley, Saline, Sedgwick, Shawnee, Stafford, Sumner, Wabaunsee, Washington, Woodson, Wyandotte	18,851,282
378	5/2/1973	Severe Storms, Flooding	Atchison, Barber, Barton, Bourbon, Brown, Butler, Chautauqua, Cherokee, Clark, Coffey, Crawford, Dickinson, Doniphan, Douglas, Edwards, Ellsworth, Ford, Franklin, Gray, Greenwood, Harper, Harvey, Haskell, Hodgeman, Jackson, Jefferson, Kingman, Kiowa, Labette, Leavenworth, Lincoln, Linn, Lyon, Marion, Marshall, McPherson, Meade, Miami, Montgomery , Morris, Nemaha, Ness, Osage, Osborne, Ottawa, Pawnee, Pottawatomie, Pratt, Reno, Republic, Rice, Rush, Russell, Saline, Sedgwick, Seward, Shawnee, Stafford, Stevens, Sumner,	8,829,200

Declaration Number	Declaration Date*	Disaster Description	Counties Involved	Constant 2006 $**
			Wabaunsee, Washington, Woodson, Wyandotte	
267	7/15/1969	Tornadoes, Severe Storms, Flooding	Allen, Anderson, Bourbon, Crawford, Dickinson, Douglas, Ellsworth, Franklin, Johnson, Leavenworth, Linn, Lyon, McPherson, Miami, Morris, Neosho, Osage, Saline, Woodson, Wyandotte	3,952,657
229	7/18/1967	Tornadoes, Severe Storms, Flooding	Anderson, Atchison, Chase, Cloud, Coffey, Crawford, Doniphan, Douglas, Finney, Franklin, Harper, Jackson, Jefferson, Kingman, Leavenworth, Linn, Lyon, Marion, Miami, Mitchell, Nemaha, Ness, Osage, Pottawatomie, Republic, Washington, Wabaunsee	5,031,351
219	6/10/1966	Tornadoes, Severe Storms	Riley, Shawnee	17,480,581
201	6/23/1965	Flooding	Barton, Butler, Chase, Edwards, Finney, Ford, Grant, Gray, Greenwood, Hamilton, Harvey, Kearny, Lyon, Marion, McPherson, Pawnee, Reno, Rice, Sedgwick, Stafford, Stanton	6,566,805
88	11/6/1958	Floods	Atchison, Clay, Cloud, Nemaha, Republic, Washington	830,839
81	9/5/1957	Floods	n/a	468,181
34	5/27/1955	Tornado	Cowley	2,184,772
Emergency Declarations				
3282	12/12/2007	Severe Winter Storms	All	n/a
3236	9/1/0/2005	Hurricane Katrina Evacuation	All	0
3126	6/9/1998	Grain Elevator Explosion	Harvey, Sedgwick	1,182,763
Fire Management Assistance Declarations				
2632	3/30/2006 (3/30-4/6/2006)	Obee Fire	Reno	n/a

Sources: Federal Emergency Management Agency, www.fema.gov/; Public Entity Risk Institute, www.peripresdecusa.org
* Incident dates are in parentheses
** Costs include Public Assistance, Individual Assistance, and mitigation and are in constant 2006 dollars with the exception of the following:
-DR 1699, which includes Public Assistance and Individual Assistance as of August 14, 2007, according to the state.
-DR 1675, which includes Public Assistance and mitigation, according to the state.

For the 2010 update, the committee obtained a map showing disaster declarations by county for federal declarations and state declarations.

Figure 3.9. Federal Disaster Occurrences

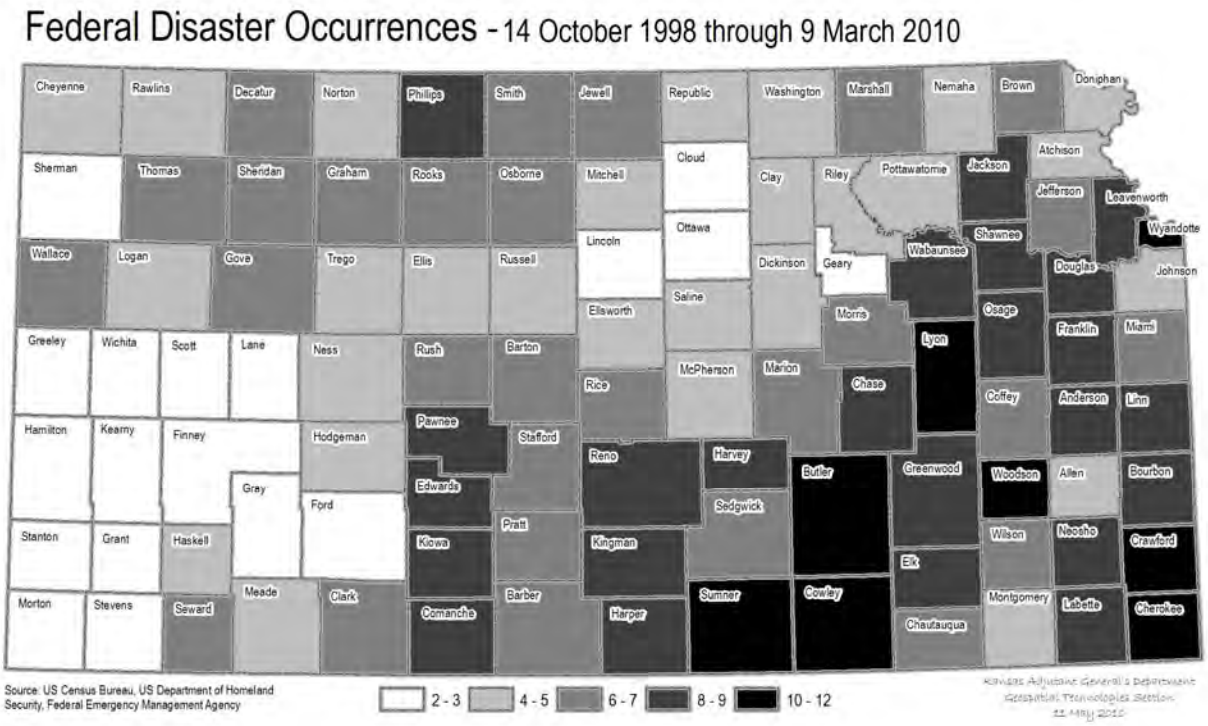
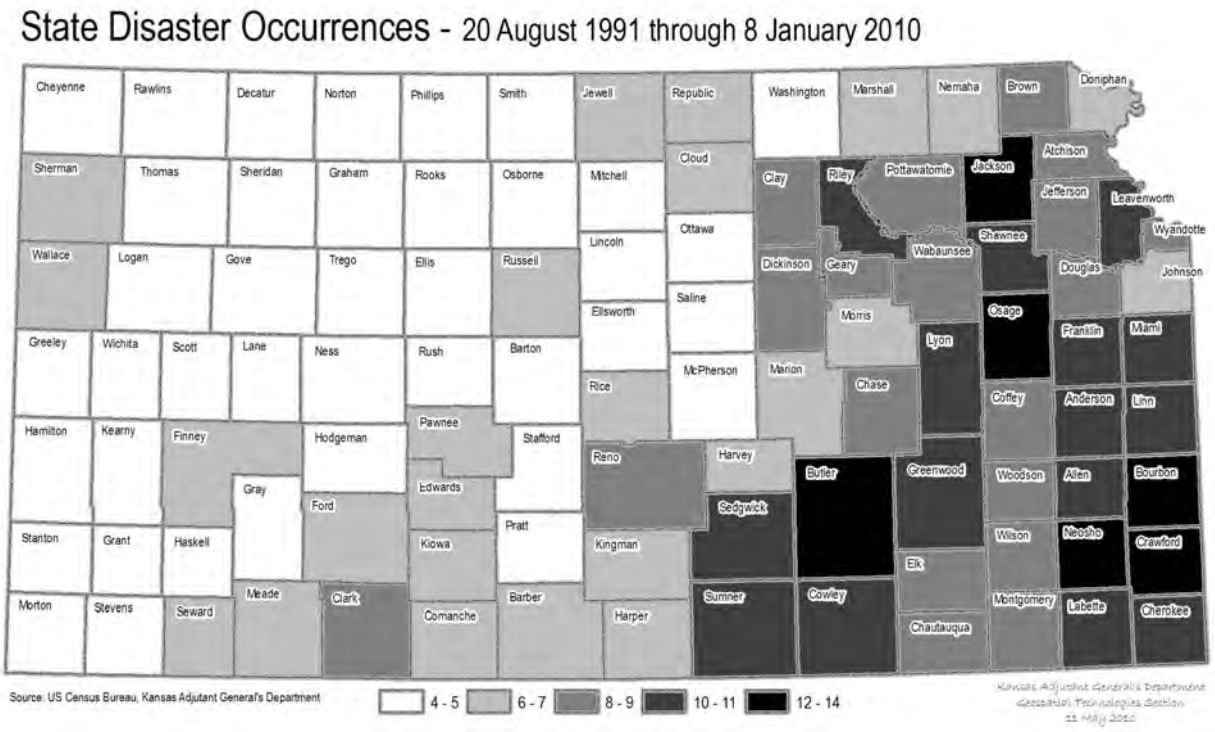


Figure 3.10. State Disaster Occurrences



3.2.2 Local Plans Hazard Identification and Risk Assessment

The state analyzed the hazard identification and potential vulnerability and loss information from local plans during the 2010 update (see Chapter 5 Coordination of Local Mitigation Planning). At the time of the state plan update, 40 local plans were FEMA-approved. A review of the hazards identified in the local plans showed them to be consistent with those identified in the state plan with minor differences in how the hazards were named (no new hazards identified). Minor exceptions included the occasional identification of certain hazards inappropriate to mitigation planning, such as crime. Some of the plans lack detailed vulnerability and loss information; this is due to the method previously used to measure relative risk for local plans using software programs. Since the state no longer uses these programs, and has provided funding to communities to use local planning contractors, the data has improved; however, there is a need for consistency amongst planners in the data gathering and the methodologies used. During this update, a database has been set up to incorporate local planning data; however, the consistency and methodology poses a problem when comparing the information gathered.

As more plans are completed, a more statistically significant sample will be available for analysis to ensure that the state is addressing the hazards most relevant to local governments. An opportunity exists for the state to help locals collect and analyze risk information so that future update cycles of this plan will have more local data to evaluate. The state may be able to assist the locals in their local plan updates by defining standard methods for identifying hazards and determining potential losses to people and structures. The state's strategy to assist with the completion of the local hazard mitigation plans is detailed in Chapter 5 Coordination of Local Mitigation Planning. Mitigation actions designed to address local plan shortfalls are listed in Chapter 4 and detailed in Appendix N: "Complete local mitigation plans" and "Refine risk/vulnerability assessment in regards to public health and improve coordination on state vulnerability assessments." In addition, information provided in this updated risk assessment can be used as a resource to support local governments as they develop the hazard profiles and vulnerability assessments in their mitigation plans.

3.3 Hazard Profiles and Vulnerability

IFR REQUIREMENT *201.4(c)(2)(i):*	[The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.
Explanation:	The plan **shall** provide an overview of the **location** of all natural hazards that can affect the State. The plan *should* describe the geographic boundaries in the State that would be affected by these hazards. Where appropriate, the hazard analysis *should* also broadly identify on a map the areas of the State affected by each hazard, noting those areas most severely affected by each hazard. A composite map (i.e., a map showing combined information from different thematic map layers) can be provided for hazards that have a recognizable geographic boundary (i.e., hazards that are known to occur in particular areas of the State), such as floods, coastal storms, wildfires, tsunamis, and landslides. For those hazards that are not geographically determined, plans *should* indicate their probable intensity. For example, for areas where tornadoes occur, plans should indicate the recorded intensities of previous events. The plan **shall** also provide a discussion of **past hazard events**. This discussion *should* include: • Information on the damages that occurred (e.g., costs of recovery, property damage, and lives lost) to the extent practicable. • Level of severity (i.e., flood depth or extent, wind speeds, earthquake intensity). • Duration of event. • Date of occurrence. • Sources of information used or consulted for assembling a history of past occurrences. The plan **shall** also include information on the **probability** of future hazard events. In addition, it *should* describe the analysis or sources used to determine the probability and their magnitudes. The plan *should* also describe conditions (i.e., topography, soil characteristics, meteorological conditions, etc.) in the planning area that mitigate the hazard effects or make the area more vulnerable to hazards.
Update	The plan update **must** continue to include occurrences of hazards profiled in the previous plan, and discuss new occurrences of hazard events. The updated plan **must** incorporate any new studies or technical information related to profiling hazards, such as new National Flood Insurance Program maps or studies, HAZUS studies, or reports from other Federal or State agencies that relate to: • Location of natural hazards; • Past hazard events; • Probability of future hazard events. While maps are not required, any maps included in the updated plan **must** be consistent with the updated information.
IFR REQUIREMENT *201.4(c)(2)(ii):*	[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2) based on estimates provided in local risk assessments The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events...
Explanation:	The plan **shall** describe which jurisdictions are most threatened and vulnerable to hazards and the process used to identify them. Identification of these jurisdictions **shall** be based on an analysis of available local risk assessments conducted throughout the State, and where not available, on State risk assessments.

Plan Update	The State **shall** describe any changes, clarifications, or refinements to the previous overview of the State's vulnerability resulting from any new or updated data, as well as information generated through local mitigation plans. The update **must** explain the process used to analyze information from the local risk assessments and adjust the statewide risk assessment, as necessary. Recognizing the differences in local risk assessments, information from local mitigation plans allows the State to better understand or describe its vulnerability in terms of the jurisdictions most threatened by natural hazards. However, the update should not attempt to include the details provided in every local mitigation plan. Recognizing that statewide vulnerability may not change much in any given three-year update cycle, this section provides an opportunity to anticipate future risk. The State **must** consider in its assessment, for jurisdictions in hazard prone areas, changes in development that may impact vulnerability such as: • Significant population increases and shifts in population to vulnerable areas; • A concentration or changes in land use or land use activities in vulnerable areas; and/or • Implementation of mitigation actions that have reduced vulnerability.
IFR REQUIREMENT 201.4(c)(2)(iii):	[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments
Explanation:	This requires States to incorporate the findings of local jurisdiction loss estimates in the State plan. The plan **shall** describe the distribution of losses across the State and *should* include specific reference to quantifying losses to local critical facilities.
Update	The State **shall** incorporate any changes, clarifications, or refinements, obtained from State-wide or local loss estimates. Recognizing the differences in local risk assessments, information from local mitigation plans allows the State to better understand or describe its vulnerability in terms of the potential losses. However, the update should not attempt to include the details provided in every local mitigation plan. Comparable to the estimating vulnerability by jurisdiction, the state **must** consider changes in development that may affect the statewide loss estimates.
IFR REQUIREMENT *201.4(d)*	Plan must be reviewed and revised to reflect changes in development.

The risks posed by the hazards identified in Section 3.2 Hazard Identification are considered sufficient by the Kansas Hazard Mitigation Team. The general level of risk posed to the people, property, and the environment and economy of the affected communities should be evaluated as part of the statewide mitigation planning effort. General profiles for each of these hazards were compiled for the previous plans. These profiles have been updated for the 2010 plan update.

Each profile describes the hazard and its potential impacts, its location in the state, previous occurrences, and its probability of future occurrences. Profiles then go on to explore vulnerability and potential losses by jurisdiction. The magnitude of the impact caused by a hazard event (past and perceived) is related directly to the vulnerability of the people, property, and the environment. This is a function of when the event occurs, the jurisdictions and community sectors affected, the resilience of the community, and the effectiveness of the emergency response and disaster recovery efforts.

The level of information presented in the profiles varies by hazard based on the amount of information available. Resources used to compile these profiles can be found at the end of the chapter. With each update of this plan, new information will be incorporated to provide an improvement in evaluation and prioritization of the hazards that affect Kansas.

During the 2010 update, each profile was updated with more historical impact information, where available. Another significant change to the risk assessment is the utilization of the county as the smallest unit of geography to assess vulnerability by jurisdiction. This is an improvement to the regions (based on groups of counties) used with the Mitigation 20/20 approach in the 2004 plan.

The following hazard profiles are listed in alphabetical order for easier reference.

3.3.1 Agricultural Infestation

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.95	8 of 22	Moderate

Description

Agricultural infestation is the naturally occurring infection of crops or livestock with insects, vermin, or diseases that render the crops or livestock unfit for consumption or use. Because of Kansas' substantial agricultural industry and related facilities and locations, the potential for infestation of crops or livestock poses a significant risk to the economy of the state.

Source: http://www.kansas.gov/kdem/EMSWeb/pdf/library/2009%20Managing%20the%20Risk.pdf

Some level of agricultural infestation is normal for Kansas farmers and ranchers. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. The levels and types of agricultural infestation appear to vary by many factors, including cycles of heavy rains and drought.

One of the key concerns regarding this hazard is the potential introduction of a rapid and economically devastating foreign animal disease, such as foot and mouth disease and bovine spongiform encephalopathy (BSE) disease, to Kansas. Because Kansas is a major cattle state, with cattle raised locally as well as imported into the state, the potential for highly contagious diseases such as these is a continuing, significant threat to the economy of the state. The loss of milk production, abortion, decrease in production, and other lasting problems resulting from an outbreak could cause continual and severe economic losses, as well as widespread unemployment. It would affect not only farmers, ranchers, and butchers, but also support and related industries.

In 2002, the state experienced a foot and mouth scare. While the disease was later determined to not be foot and mouth, the episode clearly demonstrated the level of concern and the importance of being able to quickly respond to such a disease and to quickly quarantine, treat, and/or destroy infected animals. In 2003, the first confirmed domestic case of BSE disease was reported in Washington State and required quarantining and/or destruction of several herds. These episodes illustrate the vulnerability of Kansas to such an infestation hazard.

Economically important crops in Kansas are also subject to various types of infestation. In particular, wheat is susceptible to leaf rust, wheat streak mosaic, barley yellow dwarf virus, strawbreaker, and tan spot. Significant wheat crop losses because of these diseases are well

documented in various areas of Kansas. Sorghum losses can occur when a crop is infected with sooty stripe early in the growing season. Gray leaf spot is a growing problem for corn crops.

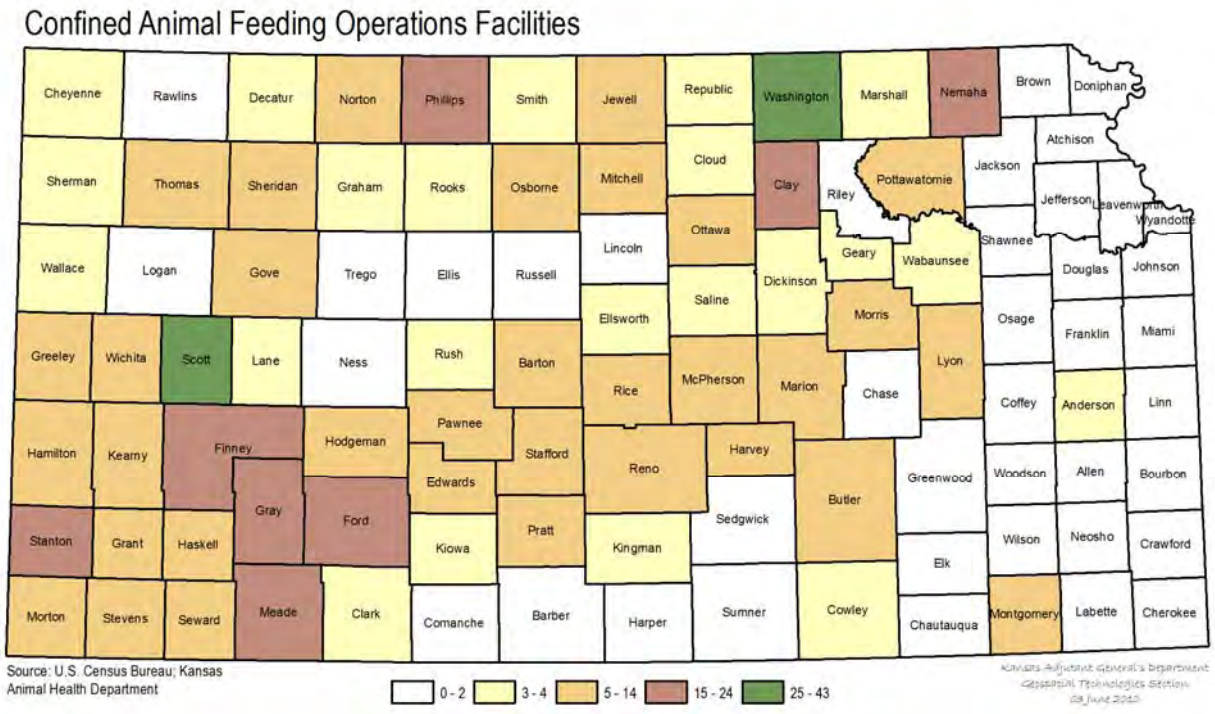
Infestation is not only a risk to crops in the field, but insect infestation can also cause major losses to stored grain. It is estimated that damage to stored grain by the lesser grain borer, rice weevil, red flour beetle, and rusty grain beetle costs the United States about $500 million annually.

There are several aspects of agricultural infestation that are directly parallel to the risk of agri-terrorism. Many experts fear that intentional, criminal introduction of a disease such as foot and mouth to one or more of Kansas stockyards would result in very rapid spread of the disease throughout the nation and could have very severe economic consequences to the industry. Additional information is provided about agri-terrorism in Section 3.3.17 Terrorism, Agri-Terrorism, and Civil Disorder.

Location

The central and western parts of the state are somewhat more susceptible to agricultural infestation. This corresponds with the areas of the state with heavier utilization of the land for crops and rangeland, as well as the location of the numerous feedlots (see Figure 3.11)

Figure 3.11. Confined Animal Feeding Operations Facilities



Please reference the Annual Feedlot Report provided in Appendix V of this plan. The Annual Feedlot Report is provided and updated by the Kansas Animal Health Department.

Figures 3.5 and 3.6 show that every county in Kansas is engaged in farming, thus, every county in Kansas is susceptible to agricultural infestation. Types and levels will vary over time, space, and conditions.

Other significant diseases include *Septoria* leaf disease, which, while statewide, was primarily in central and southeast Kansas, whereas tan spot hit north central and northeast Kansas the hardest. Stripe rust was primarily in western Kansas, while barley yellow dwarf and powdery mildew were reported more from central, south central and southeastern crop reporting districts. Scab was noted in the southern third of the state from the Missouri border into south central Kansas.

Previous Occurrences

Cumulative disease losses for the 2007 wheat crop were estimated at 17.8% of the crop (65.1 million bushels). The most current data found (from 2008) shows losses dropped to 7.7% for the year (see Table 3.12). The 2008 estimate falls below the 20 year average of 10.69% loss. In 2007, leaf rust, which was epidemic statewide, made up about 80% of the total disease loss estimate. In 2008 leaf rust again contributed to a substantial percent of the state's overall losses. Scab was the next biggest contributor to losses at 1.9% in 2008, which is well above the 0.2% from 2007. The *Septoria* leaf disease complex was responsible for 0.5% of the loss followed by tan spot with 1.3%. In 2010, several diseases were not found to any extent. Dominant in 2006, wheat streak mosaic was rarely reported. Take-all and other root and crown rots were almost nonexistent. Soil borne mosaic was reported in a few situations in western Kansas, while common bunt received a couple of reports in north central Kansas, and loose smut was reported infrequently during the survey.

Figure 3.12. Agriculture Infestation Yield Losses (%) from Disease, 2010

	2010	2009	20 yr. avg.
Stripe rust	10.3	0.01	2.14
Septoria complex	1.1	1	1.14
Leaf rust	1	1.37	3.78
Barley yellow dwarf	0.3	0.4	1.07
Head scab	0.3	0.9	0.49
Wheat streak mosaic	0.2	0.001	1.12
Tan spot	0.2	0.3	0.95
Soil borne and spindle streak	0.1	0.001	0.22
Powdery mildew	0.1	0.02	0.13
Bunt and loose smut	0.03	0.04	0.02
Root and crown rot	0.01	0.001	0.07
Take all	0.001	0.01	0.17
Stem Rust	0.001	0.001	0.06
Ceph. stripe	0.001	0.001	0

Source: Kansas State Department of Agriculture, Kansas Cooperative Plant Disease Survey Report: Preliminary 2008 Kansas Wheat Disease Loss Estimates, www.ksda.gov/plant_protection/content/183/cid/611

Other Infestations

- In 2001, a major infestation of webworms attacked the state's alfalfa crop, particularly in eastern Kansas.
- Following Midwest outbreaks of gray leaf spot between 1949 and 1986, it reached Kansas in 1989. Since then, it has spread rapidly, infesting 20 counties as of 1992.

As of mid-2010, there had not been any foreign animal disease outbreaks reported among Kansas livestock.

Local Plan Integration:

For the 2010 update, the committee reviewed all FEMA-approved Hazard Mitigation Plans. The following table illustrates the damages listed in the local plans. Note that not all local HMPs listed information for this hazard. It should also be noted that with such a limited amount of data, the local plan data would not significantly alter the states vulnerability assessment for this hazard. The data from the local plans that contained data for this hazard is located in Table 3.21.

Table 3.21. Local Plan Statistics for Agriculture Infestation

County	Crop Damage ($)	Time Frame	Average Damage Per year ($)
Dickinson	31,027	2005-2008	7756
Harper	303,778	2005-2008	75944
Harvey	16,170	2005-2007	5390
Labette	9,919	2005-2007	3306
Osage	9,570	2005-2007	3190
Reno	147,566	2005-2008	36891
Rush	172,747	2005-2007	57582
Stanton	3,358,838	2005-2007	1,116,612

Data Limitation Statement – The table above does show Stanton County as a major agriculture infestation target. Please note that these figures were only produced for two to three year periods at the local level. A mitigation item has been included in the current mitigation plan update to compile information over a larger time window. It is expected a larger time window would reflect smaller damage variations at the county level.

Using the data from the local plans throughout the state, the following statistics were calculated: Damages to Kansas crops totaled $4,049,615 from infestations in the above counties.

There are only seven counties with damages listed in their local mitigation plans, which is one fifteenth (6.67%) of the total counties in Kansas (105), and is approximately 17.5% of the local plans.

To estimate potential losses to this hazard, the planning team took the totals from the local plans available ($4,049,615) and multiplied that by 15 to come to a total for the 105 counties in the state. This number ($60,744,225) was then divided by 105 to show an average loss per county to agricultural infestation. The results are shown below:

4,049,615 x 15 = 60,744,225, 60,744,225 / 105 = 578,516

Using this formula, the calculated estimated losses per county to agricultural infestation per event is $578,516.

Probability

While some degree of agricultural infestation occurs somewhere in the state on an annual basis, this hazard's CPRI probability is "**Highly Likely**" (event is probable within the calendar year). Stripe rust was the disease of greatest importance in 2010 with a 10.3% loss or 42.5 million bushels. It represented 76% of the disease loss statewide and was equal to the largest stripe rust loss since 1976, when estimates began. Please reference the provided Plant Resource Biosecurity Response Guidelines updated by the Kansas Department of Agriculture Appendix W.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Agriculture Infestation	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible of occurring		x

Vulnerability and Potential Losses by Jurisdiction

As noted in the location description, every county in the state is potentially vulnerable with central and western counties slightly higher due to higher feedlot numbers and larger farmlands. While there are human health implications from infected food supply, it is likely the economic consequences of an agricultural infestation will be most significant. One way to estimate

vulnerability would be to inventory the value of crops and livestock exposed to the hazard. For example, according to the USDA National Agricultural Statistics Service (January 1, 2007 report), the value of the cattle and calves in the State of Kansas totaled $8.5 billion dollars. While it is difficult to estimate how much livestock would be lost in an event, a 10% loss of the cattle herd would be approximately $850 million dollars.

Development in Hazard-Prone Areas

This is not relevant to this hazard.

3.3.2 Dam and Levee Failure

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.35	17 of 22	**Moderate**

Description

Kansas is a state with many dams, impoundments, and levees. The failure of these structures could result in injuries, loss of life and property, and environmental, and economic damage. While levees are built solely for flood protection, dams often serve multiple purposes, one of which may be flood control. Severe flooding and other storms can increase the potential that dams and levees will be damaged and fail as a result of the physical force of the flood waters or overtopping.

Dams and levees are usually engineered to withstand a flood with a computed risk of occurrence. If a larger flood occurs, then that structure will likely be overtopped. If during the overtopping the dam or levee fails or is washed out, the water behind it is released as a flash flood. Failed dams and levees can create floods that are catastrophic to life and property because of the tremendous energy of the released water. Similarly, levees in Kansas were largely constructed to protect agricultural land and not built to design standards established to protect people and property.

According to the state's dam inventory, Kansas has 6,096 state-regulated dams of varying size, purpose, and vulnerability to failure (as of May 2010). According to the Kansas Division of Water Resources, a state-regulated "dam" means any artificial barrier including appurtenant works with the ability to impound water, wastewater, or other liquids that has a height of 25 feet or more; or has a height of six feet or greater and also has the capacity to impound 50 or more acre feet. The height of the dam is measured from the downstream toe to the top of the dam if a watercourse is affected or from the lowest elevation of the outside limit of the dam to the top of the dam for barriers that do not extend across a stream or watercourse. The 2009 Kansas Water Plan states that some dams are exhibiting structural deficiencies because of age, while post-construction development downstream of others has raised their hazard class. Of the 6,096 dams, 209 are designated as high hazard (Kansas class C), 213 as significant hazard (Kansas class B), and 5,674 as low hazard (Kansas class A). These designations are risk-based and do not reflect the physical condition of dams. Kansas classifies their dams as follows:

- Class C (high hazard)—A "hazard class C dam" shall mean a dam located in an area where failure could result in any of the following: extensive loss of life, damage to more than one home, damage to industrial or commercial facilities, interruption of a public utility serving a large number of customers, damage to traffic on high-volume roads that meet the requirements for hazard class C dams or a high-volume railroad line, inundation of a frequently used recreation facility serving a relatively large number of persons, or two or more individual hazards described in hazard class B.

- Class B (significant hazard)—A "hazard class B dam" means a dam located in an area where failure could endanger a few lives, damage an isolated home, damage traffic on moderate volume roads that meet the requirements for hazard class B dams, damage low-

volume railroad tracks, interrupt the use or service of a utility serving a small number of customers, or inundate recreation facilities, including campground areas intermittently used for sleeping and serving a relatively small number of persons.

- Class A (low hazard)—A “hazard class A dam” means a dam located in an area where failure could damage only farm or other uninhabited buildings, agricultural or undeveloped land including hiking trails, or traffic on low-volume roads that meet the requirements for hazard class A dams.

The state requires emergency action plans for all high and significant hazard dams. Of the 209 high hazard dams, 158 have emergency action plans, and of the 213 significant hazard dams, 28 have emergency action plans.

The average age of the 4,146 dams with completion dates in the state’s inventory database is 38 years old, and some of them are exhibiting structural deficiencies. Common problems with older dams include:

- Deteriorating metal pipes and structural components,
- Inadequate hydrologic capacity,
- Increased runoff because of upstream development, and
- Increased failure hazard because of downstream development.

Nationally, there is growing concern that many small flood control dams, which were built by local watershed districts with U.S. Department of Agriculture technical and financial assistance are at or near the end of their 50-year planned design life. There are 776 watershed dams in Kansas built with this support that now qualify for rehabilitation assistance along with 55 other watershed dams (for a total of 831).

There are also 38 dams in Kansas that are maintained and operated by the federal government, primarily the U.S. Army Corps of Engineers and the Bureau of Reclamation. Other operators are the U.S. Fish and Wildlife Service, U.S. Department of Defense, and the U.S. Army.

Location

Most of the dams in Kansas are in the central and eastern parts of the state (See Figure 3.13).

Figure 3.13 High and Significant Hazard Dams in Kansas

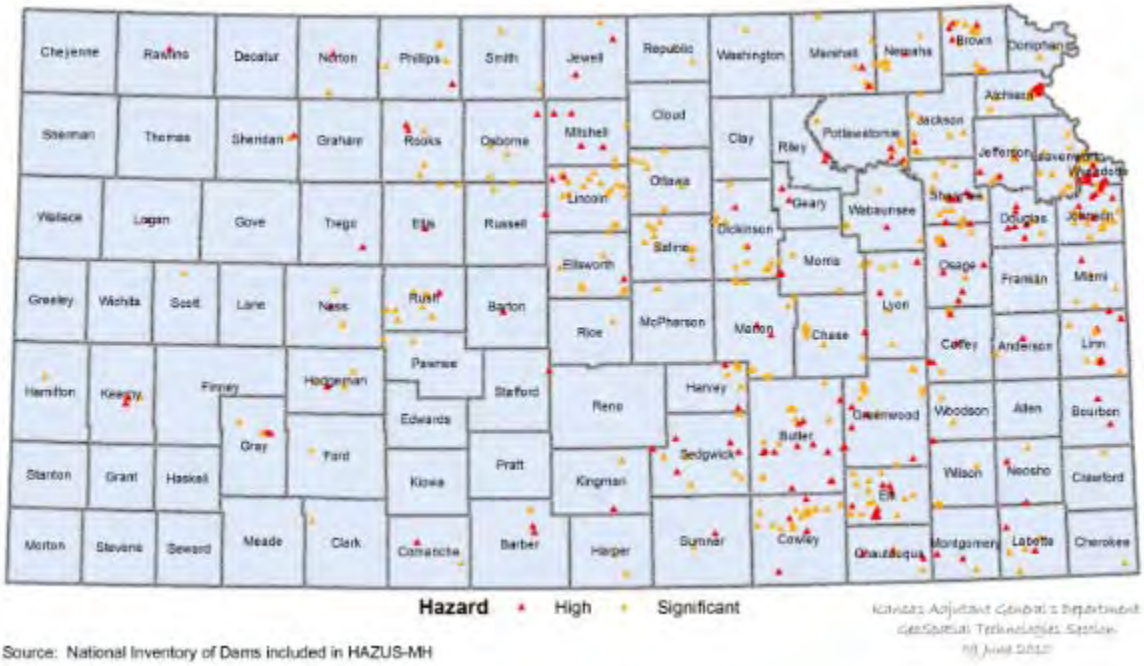


Figure 3.14 Kansas Rivers, Reservoirs and Major River Basins

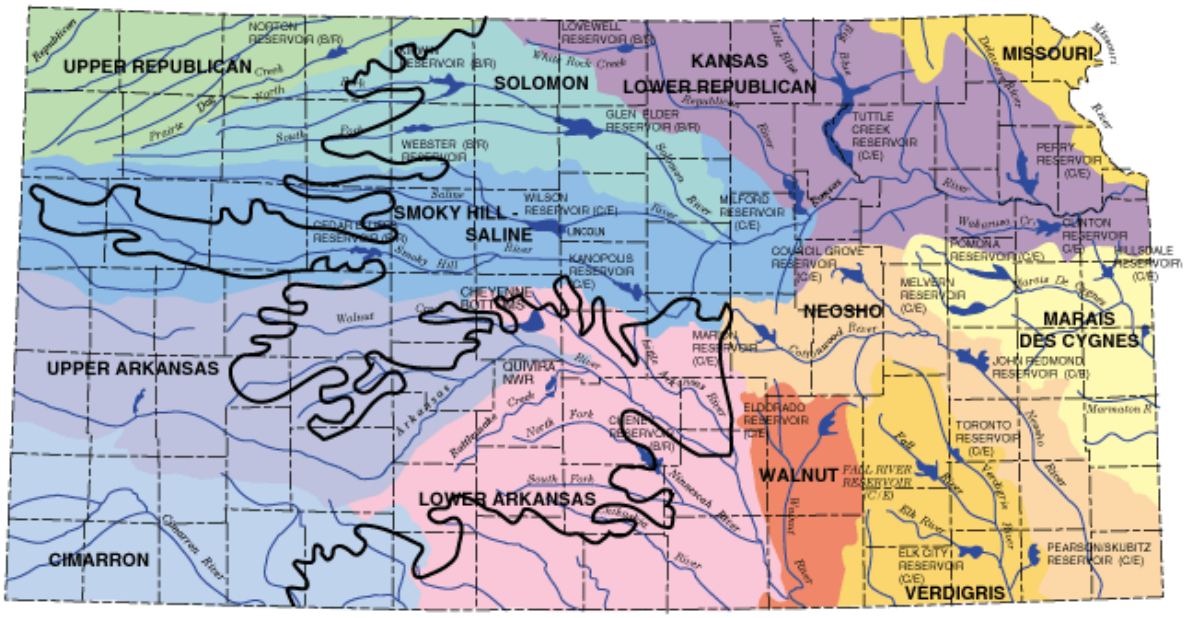


Figure 2. Kansas Rivers and Reservoirs (B/R = Bureau of Reclamation; C/E = Corps of Engineers) and major river basins. The two largest Kansas wetlands (Cheyenne Bottoms and Quivira National Wildlife Refuge, NWR) are also shown. The area west of the solid black line shows the extent of The High Plains aquifer in Kansas.

Source: Surface Water in Kansas and its Interactions with Groundwater, 2000, www.kgs.ku.edu/HighPlains/atlas/atswqn.htm

More information about the location of dams and levees can be found in the Vulnerability and Potential Losses by Jurisdiction section.

Previous Occurrences

Historically, levee and dam failures have had significant impacts in Kansas. During the spring floods of 1993, which covered nine Midwest states, a high percentage of crop acres in the U.S. Army Corps of Engineers Kansas City District floodplain areas suffered losses because of overtopping of nine of the 15 units in the federally constructed Missouri River Levee System and virtually all the nonfederal farm levees in the district. In 1998, heavy rains and high winds damaged three Kansas reservoirs: Council Grove, John Redmond, and Fall River, all of which are high hazard dams.

June 1924: The Mission Lake Dam and Spillway, in Horton, Kansas, was completed in 1924. During the period of June 7-8 and 15-18, 1925, heavy rainfall caused the dam to overtop and a section just west of the spillway washed out. Total rainfall reports from the U.S. Weather Bureau for this period show a total of 14.30 inches over the 12-day period. No deaths, injuries, or property damage was indicated.

Photo of Mission Lake Dam in 1924

Photo of Mission Lake Dam in 1924

Probability

Dam Failure The variability of the size and construction of the dams in Kansas makes estimating the probability of dam failure difficult on any scale less than a case-by-case basis. This hazard's CPRI probability is "**Unlikely**" (event is possible within the next 10 years).

Levee Failure

Based on current historical data pertaining to damaging/significant Levee Failure incidents in the State of Kansas, This hazard's CPRI probability is "**Unlikely**" (event is possible within the next 10 years).

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	**Dam and Levee Failure**	Y	N
4 - Highly Likely	Event is probable within the calendar year.		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year.		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years.		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x

	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years	x	
	Event has up to 1 in 10 years chance of occurring (1/10=10%)	x	
	History of events is less than or equal to 10% likely per year	x	
	Event is "Unlikely" but is possible to occur	x	

Vulnerability and Potential Losses by Jurisdiction

Based on the distribution of high and significant hazard dams shown in Figure 3.13, the eastern half of the state is potentially more vulnerable to a dam failure event. The risk for dam failure is highest for the Kansas Lower Republican River Basin (see Figure 3.14). This is because of the U.S. Army Corps of Engineer's Tuttle Creek dam in Riley, Pottawatomie, and Marshall Counties, and the risk it poses to downstream populated areas and property. The dam is located on the Big Blue River, nine miles upstream from the confluence of the Blue and Kansas Rivers. It is situated near the Humboldt fault line, which is associated with the Nemaha uplift. Earthquake models show that the dam could be significantly damaged to the point that the lake could wash out the dam. Should the Tuttle Creek dam fail, Manhattan would be hit the hardest; a significant portion of its business and industrial areas would be inundated. Topeka and Lawrence as well as smaller communities along the Kansas River would also feel the impact. Levees downstream in Topeka, Lawrence, and Kansas City could also break. Upstream, the damage would be economic as recreational opportunities would be adversely affected. While the probability of a significant earthquake event is low, efforts are under way to shore up the dam to withstand a moderate to large earthquake.

For the other river basins of the state, the risk for dam failure as a hazard is not considered high by the state. However, because of the large number of dams in the state, and the wide variability in impact should there be a failure, a statewide approach to analysis of this hazard could understate the level of local risk in specific areas. The state will look more closely at local hazard mitigation plans as they become available.

The largest number of dams also coincides with some of the more heavily populated counties. Inundation mapping in GIS formats could be used to assess populations and buildings downstream of many of these dams, but these maps are only available downstream of federally maintained and operated structures such as Bureau of Reclamation and U.S. Army Corp of Engineer dams. These agencies do not release this kind of information to the public because of homeland security concerns. Table 3.22 shows how the distribution of state-regulated dams breaks down by county. Table 3.22 contains information about the 24 federally maintained and operated reservoirs that are of concern to Kansas.

Table 3.22. Kansas State-Regulated High and Significant Hazard Dams by County

County	2008 Population	Total Dams	Total High Hazard Dams (# without emergency action plans)	Total Significant Hazard Dams
Allen	13,203	23	0	1
Anderson	7,872	51	1 (1)	1
Atchison	16,411	175	18 (1)	10
Barber	4,593	93	2 (1)	0
Barton	27,464	19	1	0
Bourbon	14,884	72	5 (2)	4
Brown	9,927	220	4 (1)	13
Butler	64,084	232	11 (5)	9
Chase	2,798	83	0	7
Chautauqua	3,745	84	3 (1)	1
Cherokee	21,064	6	0	0
Cheyenne	2,700	27	0	0
Clark	2,081	20	0	0
Clay	8,704	46	0	0
Cloud	9,263	36	0	0
Coffey	8,436	53	0	5
Comanche	1,873	27	1 (1)	1
Cowley	33,634	128	4 (3)	14
Crawford	38,869	59	1 (1)	1
Decatur	2,855	33	0	0
Dickinson	19,015	93	2 (2)	5
Doniphan	7,624	100	0	1
Douglas	116,383	97	7 (1)	3
Edwards	3,071	3	0	0
Elk	3,001	85	4 (4)	5
Ellis	27,739	27	1	0
Ellsworth	6,179	63	1 (1)	2
Finney	42,074	57	1	0
Ford	33,692	16	0	0
Franklin	26,441	68	0	2
Geary	31,751	12	2 (2)	0
Gove	2,480	22	0	0
Graham	2,435	49	0	0
Grant	7,353	6	0	0
Gray	6,005	17	5 (1)	0
Greeley	1,234	4	0	0
Greenwood	6,666	155	3 (3)	9
Hamilton	2,625	31	0	0
Harper	5,667	22	0	1
Harvey	34,247	29	3 (2)	3
Haskell	4,006	2	0	0

County	2008 Population	Total Dams	Total High Hazard Dams (# without emergency action plans)	Total Significant Hazard Dams
Hodgeman	1,906	28	1 (1)	2
Jackson	13,412	250	1	6
Jefferson	18,207	312	0	6
Jewell	3,059	57	0	1
Johnson	542,737	103	20 (7)	14
Kearny	4,169	24	3 (2)	1
Kingman	7,571	29	1 (1)	0
Kiowa	2,322	8	0	0
Labette	21,776	58	0	3
Lane	1,742	24	0	0
Leavenworth	75,227	169	4 (2)	6
Lincoln	3,123	95	3 (3)	11
Linn	9,335	81	8 (7)	7
Logan	2,549	20	0	1
Lyon	33,601	108	2 (1)	12
Marion	11,982	25	1 (1)	1
Marshall	10,123	121	4 (4)	7
McPherson	28,866	26	0	1
Meade	4,407	17	0	0
Miami	30,969	68	1	5
Mitchell	6,344	42	2	3
Montgomery	34,254	40	2 (1)	0
Morris	5,994	50	2 (2)	2
Morton	3,031	0	0	0
Nemaha	9,968	193	2 (1)	3
Neosho	16,046	65	1 (1)	1
Ness	2,835	44	1	1
Norton	5,330	61	0	0
Osage	16,104	52	5 (1)	5
Osborne	3,849	92	0	3
Ottawa	5,974	112	2 (2)	5
Pawnee	6,206	22	0	1
Phillips	5,272	67	0	0
Pottawatomie	19,994	91	4 (2)	3
Pratt	9,304	9	0	0
Rawlins	2,425	28	2 (2)	1
Reno	63,357	18	0	0
Republic	4,808	33	0	1
Rice	10,079	17	0	0
Riley	71,341	16	3 (3)	0
Rooks	4,984	57	0	2
Rush	3,143	35	0	7

County	2008 Population	Total Dams	Total High Hazard Dams (# without emergency action plans)	Total Significant Hazard Dams
Russell	6,596	36	0	0
Saline	54,364	95	1 (1)	4
Scott	4,560	7	0	0
Sedgwick	490,864	78	4 (4)	4
Seward	23,013	6	0	0
Shawnee	176,255	151	6 (4)	3
Sheridan	2,435	14	0	1
Sherman	5,860	10	0	0
Smith	3,753	82	0	1
Stafford	4,342	2	0	0
Stanton	2,107	12	0	0
Stevens	5,129	8	0	0
Sumner	23,488	11	1 (1)	1
Thomas	7,343	10	0	0
Trego	2,920	23	0	0
Wabaunsee	6,846	50	2	6
Wallace	1,408	11	0	0
Washington	5,683	38	0	2
Wichita	2,109	10	0	0
Wilson	9,474	41	1	0
Woodson	3,240	42	0	1
Wyandotte	155,085	44	13 (5)	4
Sources: U.S. Census Bureau, Kansas Department of Agriculture Water Structures Program				

Table 3.23. Federal Reservoirs in Kansas

Reservoir	Year Storage Began	Operating Agency*	Contributing Drainage Area (square miles)	Conservation Pool	
				Surface Area (acres)	Estimated 2004 Storage Capacity (acre feet)
Big Hill (Pearson-Skubitz)	1981	COE	37	1,192	26,650
Cedar Bluff	1950	BOR	5,530	6,869	170,658
Cheney	1964	BOR	933	9,540	143,427
Clinton	1977	COE	367	7,120	120,643
Council Grove	1964	COE	246	3,314	43,176
El Dorado	1981	COE	234	7,911	157,973
Elk City	1966	COE	634	4,188	38,385
Fall River	1949	COE	585	2,329	19,433
Glen Elder (Waconda)	1967	BOR	5,076	12,602	217,426
Hillsdale	1981	COE	144	4,576	71,950
John Redmond	1964	COE	3,015	8,084	44,385
Kanopolis	1948	COE	2,327	3,252	43,121
Kirwin	1955	BOR	1,373	4,937	99,435
Lovewell	1957	BOR	364	2,986	41,690
Marion	1968	COE	200	6,220	75,133
Melvern	1970	COE	349	6,885	147,973
Milford	1964	COE	3,796	15,314	351,577
Norton (Keith Sebelius)	1964	BOR	712	2,180	34,330
Perry	1966	COE	1,117	10,447	199,824
Pomona	1962	COE	322	3,865	59,642
Toronto	1960	COE	730	2,580	15,734
Tuttle Creek	1963	COE	9,628	12,617	253,265
Webster	1956	BOR	1,125	3,445	77,370
Wilson	1965	COE	1,917	9,000	243,000

Source: Kansas Water Office

* BOR—U.S. Department of Interior Bureau of Reclamation; COE—U.S. Army Corps of Engineers

Table 3.24 lists counties in Kansas that are known to have a levee and includes information on the design level, flooding source, and protected community, where known. It is not intended to represent how many levees there are, but where they exist and what communities are protected by them. There is a new row in the table where the flooding source or protected community changes within a particular county. The table is compiled from three different sources: The online FEMA Levee Inventory System, another FEMA list for flood map modernization purposes, and a U.S. Army Corps of Engineers spreadsheet. In some cases, the information on these lists conflicted, such as the design level (differences are preserved in the table), and no single list was comprehensive. There is a nationwide effort underway to certify that levees provide protection to the design level intended. As a result, more comprehensive information about levees in Kansas should be available for the 2013 update to this plan.

Kansas has one levee on the U.S. Army Corps of Engineer's published list of levees of concern for 2007: the levee at Ft. Leavenworth in Leavenworth County. The levee was removed from the list for 2009 as seen in Appendix Y. The "Levee of Maintenance Concern" rating is designated by past flooding history and relative populations at risk. Structural designation is still maintained and updated by stakeholders involved. This levee was breached by the large flood events in 1951 and 1993 (see Section 3.3.7 Flood).

Table 3.24. Levees in Kansas

County	Levee Design Level	Flooding Source	Protected Community	Federal Levee?
Allen	100-yr (500-yr)	Neosho River	Iola	unknown
Atchison	24 yr	Missouri River	unincorporated areas	unknown
Barton	100-yr	AR River	Great Bend	yes
Barton	100-yr	AR River	unincorporated areas	yes
Barton	100-yr	Walnut Creek Diversion Channel	unincorporated areas	yes
Butler	100-yr	West Branch Walnut River	El Dorado	unknown
Butler	unknown	Whitewater River	Augusta	unknown
Butler	unknown	Whitewater River	unincorporated areas	unknown
Butler	unknown	Walnut River	Augusta	unknown
Butler	unknown	Walnut River	unincorporated areas	unknown
Cloud	unknown	Elk Creek	Clyde	unknown
Cowley	100-yr	Timber Creek	Winfield	yes
Cowley	100-yr	Walnut River	Winfield	yes
Dickinson	100-yr (500-yr)	Mud Creek	Abilene	unknown
Doniphan	500-yr	Missouri River	unincorporated areas	unknown
Douglas	100-yr	Kansas River	Lawrence	yes
Douglas	100-yr	Kansas River	unincorporated areas	yes
Douglas	100-yr	Mud Creek	unincorporated areas	yes
Ellis	100-yr?	Big Creek/Smoky Hill	Hays	unknown
Ford	unknown	Arkansas River	unincorporated areas	unknown
Ford	unknown	Arkansas River	Dodge City	unknown
Franklin	100-yr	Marais Des Cygnes	Ottawa	yes
Franklin	100-yr	Marais Des Cygnes	unincorporated areas	yes
Geary	100-yr	unknown	unincorporated areas	unknown
Geary	100-yr	Kansas River	unincorporated areas	unknown
Geary	100-yr	Republican River	unincorporated areas	unknown
Harvey	500-yr	Little Arkansas River	unincorporated areas	unknown
Harvey	unknown	unknown	Halstead	unknown
Jefferson	unknown	unknown	unknown	unknown
Leavenworth	100-yr	Kansas River	unincorporated areas	unknown
Lincoln	100-yr	Salt Creek	Barnard	unknown
Lyon	100-yr	Grand Neosho River	Hartford	yes
Marion	100-yr (200-yr)	Cottonwood River	Florence	unknown
Marion	unknown	Cottonwood River	Marion	unknown
Marshall	unknown	Black Vermillion River	Frankfort	unknown
Miami	100-yr	Marais des Cygnes River	Osawatomie	unknown
Miami	100-yr	Pottawatomie Creek	Osawatomie	unknown
Montgomery	100-yr	Duck Creek	Elk City	unknown
Montgomery	100-yr	Verdigris River	Independence	unknown

County	Levee Design Level	Flooding Source	Protected Community	Federal Levee?
Montgomery	100-yr	Verdigris River	Coffeyville	unknown
Neosho	100-yr (500-yr)	Santa Fe Lake	Chanute	unknown
Pawnee	500-yr	Pawnee River	Larned	unknown
Pottawatomie	unknown	Kansas River/Big Blue River	Manhattan	unknown
Reno	100-yr	Arkansas River	Hutchinson	unknown
Reno	100-yr	Arkansas River	unincorporated areas	unknown
Reno	100-yr	Cow Creek	Hutchinson	unknown
Reno	100-yr	Plum Creek	Hutchinson	unknown
Riley	unknown	Kansas River/Big Blue River	Manhattan	unknown
Riley	unknown	Kansas River/Big Blue River	unincorporated areas	unknown
Riley	unknown	Kansas River	unincorporated areas	unknown
Saline	100-yr	Dry Creek	Salina	yes
Saline	unknown	Gypsum Creek, Spring Creek, Bull Run Creek	Gypsum	unknown
Saline	100-yr	Mulberry Creek Overflow	unincorporated areas	yes
Saline	100-yr	Smoky Hill River	Salina	yes
Saline	unknown	Smoky Hill River	unincorporated areas	unknown
Saline	100-yr	Spring Creek	unincorporated areas	yes
Saline	100-yr	Gypsum Creek	unincorporated areas	yes
Saline	unknown	Gypsum Creek	Gypsum	unknown
Sedgwick	100-yr	Wichita Valley Center Floodway	Haysville	unknown
Sedgwick	100-yr	Wichita Valley Center Floodway	unincorporated areas	unknown
Sedgwick	unknown	Wichita Valley Center Floodway	Wichita	unknown
Sedgwick	unknown	Little Arkansas River	unincorporated areas	unknown
Sedgwick	unknown	Little Arkansas River	Wichita	unknown
Sedgwick	unknown	Arkansas River	unincorporated areas	unknown
Sedgwick	unknown	Arkansas River	Wichita	unknown
Shawnee	100-yr	unknown	Topeka	unknown
Shawnee	100-yr	Bourbonais Creek	unincorporated areas	unknown
Shawnee	100-yr	Kansas River	Topeka	unknown
Shawnee	100-yr	Kansas River	unincorporated areas	unknown
Shawnee	500-yr	Kansas River	Topeka	unknown
Shawnee	500-yr	Soldier Creek	Topeka	unknown
Shawnee	100-yr	Soldier Creek	Topeka	unknown
Shawnee	100-yr	Soldier Creek	unincorporated areas	unknown
Shawnee	100-yr	Shunganunga Creek	Topeka	unknown
Shawnee	100-yr	Shunganunga Creek	unincorporated areas	unknown
Wyandotte	100-yr	Kansas River	Kansas City	yes
Wyandotte	100-yr?	Kansas River	unincorporated areas	yes
Wyandotte	100-yr (500-yr)	Missouri River	Kansas City	Yes
Sources: U.S. Corps of Army Engineers, Federal Emergency Management Agency Levee Inventory System				

Local Plan Integration:

There was no data for this hazard obtained from any of the local plans throughout the State of Kansas; therefore the committee could not provide an assessment on a local level for dam failure.

Development in Hazard-Prone Areas

As population and urban expansion downstream of significant and low hazard dams increases, so does their hazard class. A class change may require upgrades to meet higher design standards. These upgrades, as well as the costs of routine maintenance, inspections, and upkeep, are becoming challenges for many dam owners. Currently, the state does not require local governments to regulate development in dam inundation areas. Note the high number of dams in the fast growing counties of Johnson, Douglas, Butler, and Leavenworth.

Levees can sometimes provide a false sense of security, leading to more development on the dry side of the levee. If the levee is overtopped or fails, the results could be disastrous. It is not known if this kind of development is occurring in Kansas.

3.3.3 Drought

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.35	16 of 22	**Moderate**

Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. It can also be defined in terms of meteorology, agriculture, and hydrology. Although drought is not predictable, long-range outlooks may indicate an increased chance of drought, which can serve as a warning (P.L. 109-430 established a National Integrated Drought Information System within the National Oceanic and Atmospheric Administration to improve drought monitoring and forecasting capabilities). A drought period can last for months, years, or even decades. It is rarely a direct cause of death, though the associated heat, dust, and stress can all contribute to increased mortality.

Each year, an estimated 18% of the United States is impacted by drought and the nation incurs an estimated $6 to $8 billion in drought-related losses. The 1988–89 drought damage was estimated at $40 billion nationally. It is believed, that the drought in the 1930s could have exceeded this damage level.

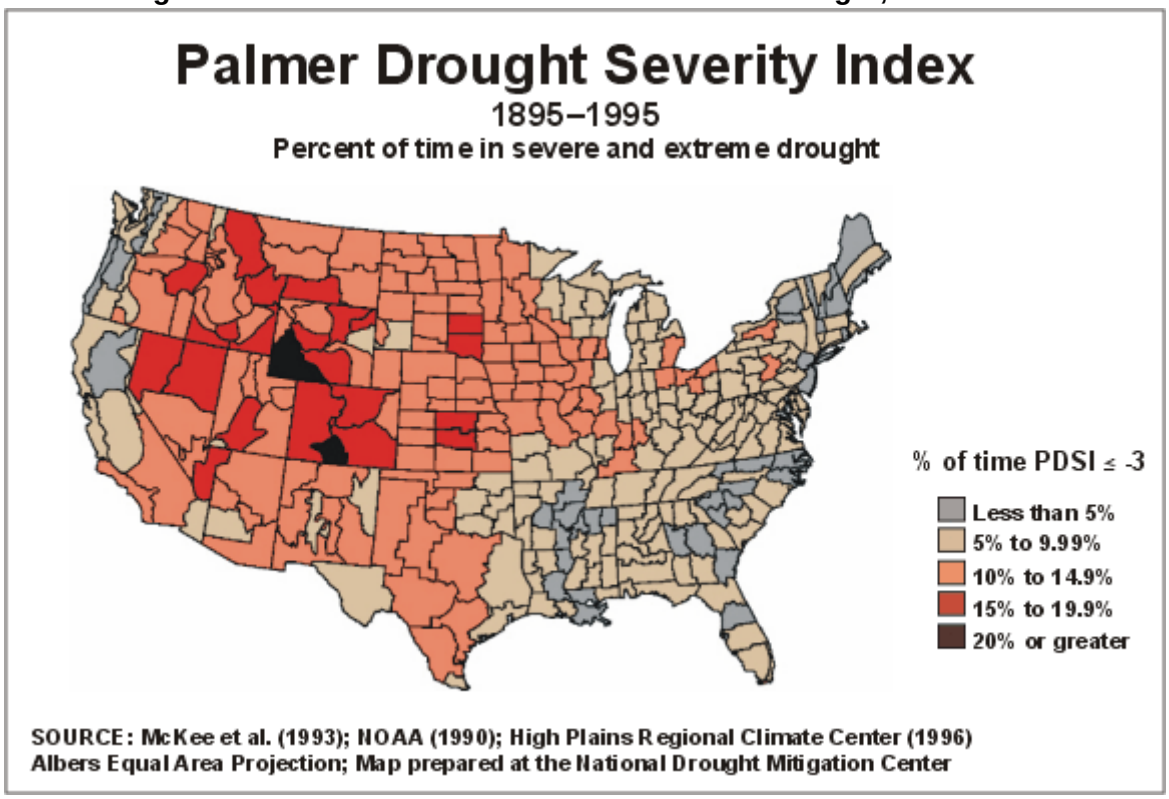
Periods of drought are normal occurrences in all parts of Kansas. Drought in Kansas is caused by severely inadequate amounts of precipitation that adversely affect farming and ranching, surface and ground water supplies, and uses of surface waters for navigation and recreation. Because of these impacts, drought can have significant economic and environmental impacts. Drought can also create favorable conditions for wildfires and wind erosion (See Section 3.3.20 Wildfire and Section 3.3.16 Soil Erosion and Dust).

More information can be found in Appendix S Kansas Drought Vulnerability.

Location

Figure 3.15 indicates that all of Kansas has experienced drought. For the 100-year period 1895-1995, most of Kansas was in severe or extreme drought 10-14.9% of the time, and the central and north-central portions of the state were in severe or extreme drought 15-19.9% of the time.

Figure 3.15. United States: Percent of Time in Drought, 1895–1995



The U.S. Drought Monitor is a composite of several observed weather variables and drought indices that is updated weekly. It is the primary drought monitoring tool. The March 30, 2010, map (see Figure 3.16), shown here as an example, indicated no abnormally dry conditions in Kansas. No part of the state was classified as abnormally dry, compared with 12% on July 31, 2007, and none on June 26, 2007. There were no county drought stage (moderate drought) declarations in effect at the time.

Figure 3.16. Kansas Drought Conditions, March 30, 2010

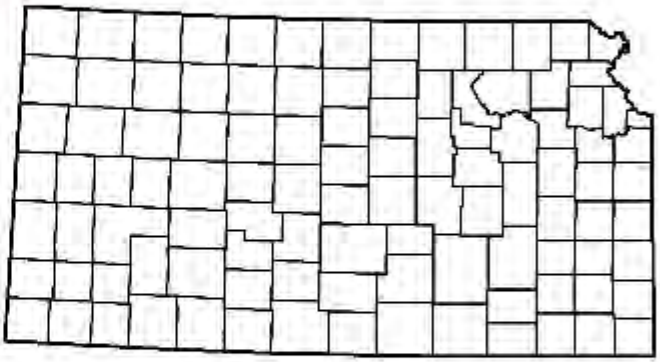
U.S. Drought Monitor

Kansas

March 30, 2010
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	100.0	0.0	0.0	0.0	0.0	0.0
Last Week (03/23/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
3 Months Ago (01/05/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
Start of Calendar Year (01/05/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
Start of Water Year (10/06/2009 map)	99.8	0.2	0.0	0.0	0.0	0.0
One Year Ago (03/31/2009 map)	41.0	59.0	7.2	3.1	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

http://drought.unl.edu/dm

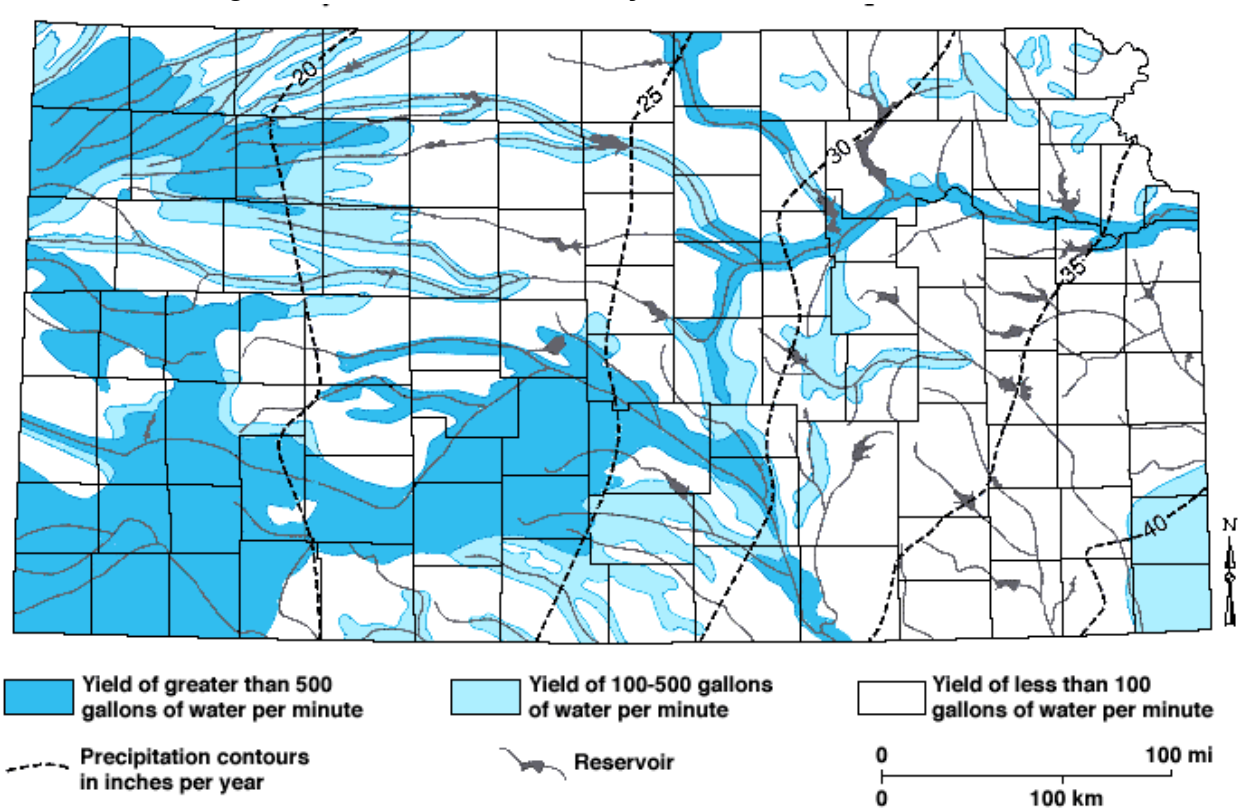
Released Thursday, April 1, 2010
Author: M. Rosencrans, CPC/NOAA

In eastern Kansas, the primary source of water is surface water: rivers, federal reservoirs, multipurpose small lakes, and municipal lakes. In western Kansas, the primary source is groundwater drawn from wells that reach into the water bearing aquifers. While 68% of the state's public water systems rely upon groundwater sources, these systems serve only 29% of the population. The High Plains aquifer in western Kansas is perhaps the dominant characteristic of the state when considering groundwater resources (see Figures 3.17 and 3.18).

Figure 3.17. High Plains Aquifer

Source: Kansas State Geological Survey, http://www.kgs.ku.edu/HighPlains/index.shtml
Note: Yellow represents the aquifer.

Figure 3.18. General Availability of Ground Water in Kansas



Source: Kansas Geological Survey, www.kgs.ku.edu/Hydro/hydroSheetMap.html

Twenty-four federal reservoirs have been built in the state, seventeen by the U.S. Army Corps of Engineers and seven by the U.S. Bureau of Reclamation. The twenty-four reservoirs have a total conservation or multi-purpose storage capacity of 2.7 million acre-feet. This total does not include exclusive flood control storage. As part of the state's water marketing or water assurance programs, the state has contracted with the federal government for water-supply storage in thirteen of these reservoirs operated by the U.S. Army Corps of Engineers (see Figure 3.19). Water from this storage is sold to municipal and industrial users and is also released during times of low-flow for use by water assurance district members (see discussion of sedimentation in these reservoirs in Section 3.3.16 Soil Erosion and Dust).

The Federal Reservoirs in figure 3.19 below can aid in providing water to the state during drought conditions

Figure 3.19. Federal Reservoirs with State Storage

Source: Kansas Water Office, www.kwo.org/ReservoirInformation/Map_Federal_Lakes_State_Storage.pdf
Note: All reservoirs are operated by the U.S. Army Corps of Engineers with the exception of Cedar Bluff. The state owns storage in the Cedar Bluff reservoir, but it is not part of the water marketing or water assurance program.

Dam Failure is also a risk in potential drought conditions. Federal and state guidelines define high-hazard dams as ones which, in a failure, probably would kill at least one person.

Figure 3.20. Kansas Dams with High Hazard Ranking

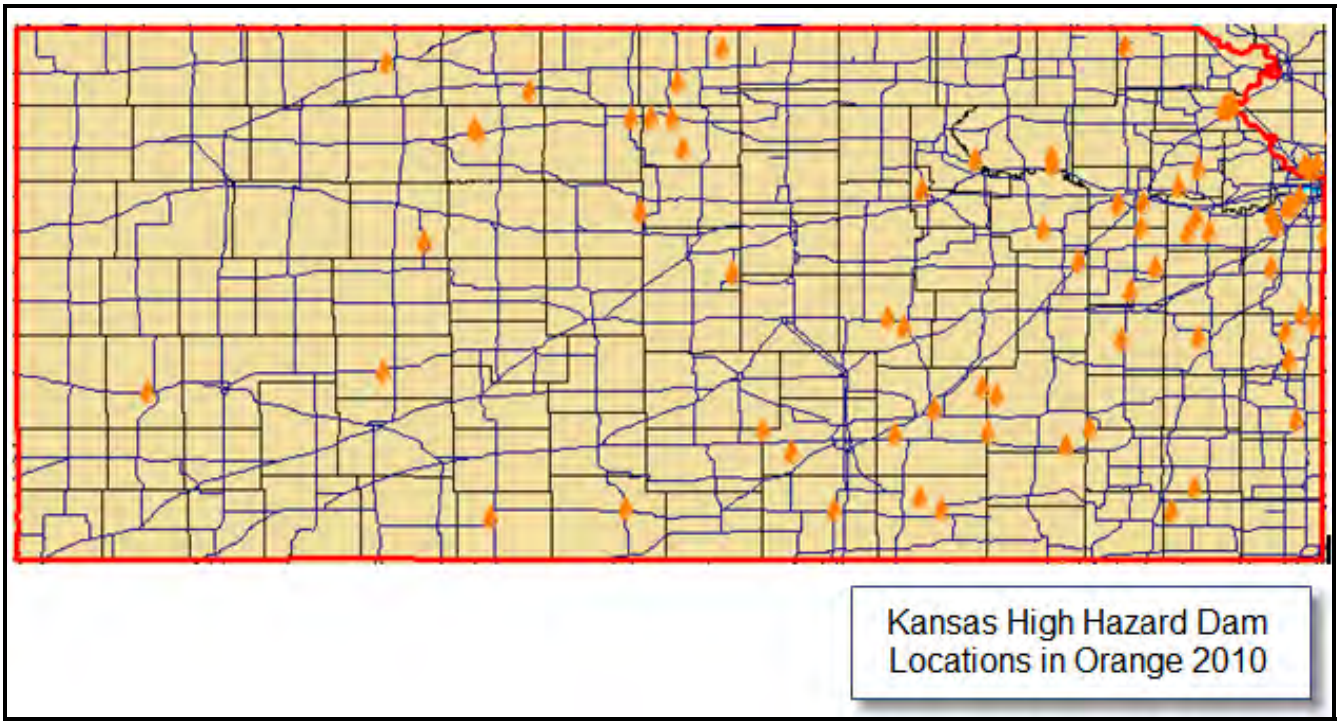
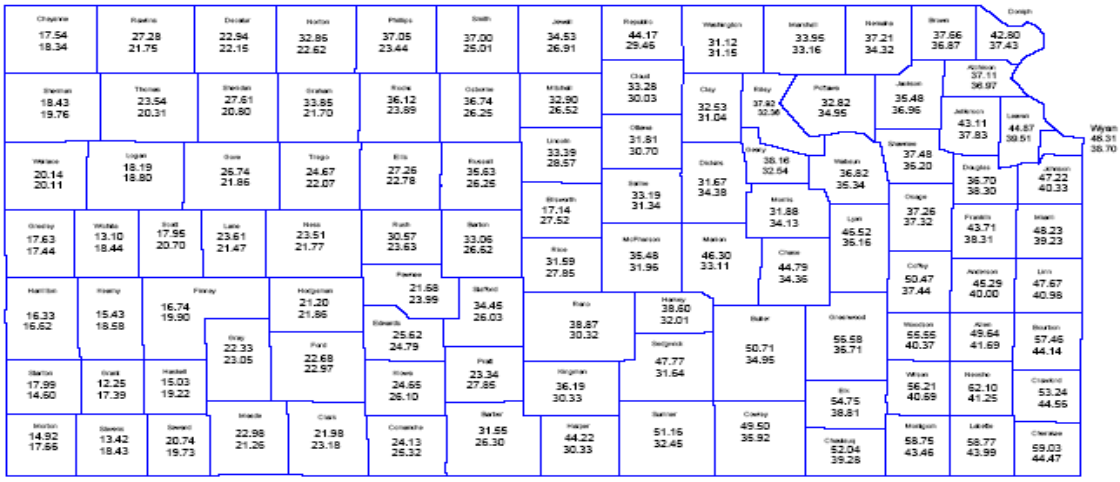


Figure 3.21 shows the precipitation for the State of Kansas for 2008 and also the average of precipitation for 1971-2000. In Section 3.3.7 Flood, Figure 3.34 shows the distribution of water runoff in Kansas. Although the climatically controlled rainfall variation is significant, average annual runoff across the state varies much more than the precipitation. The average runoff ranges from approximately 10 inches in the east (25% of precipitation) to 0.1 inch in the west (less than 0.6 of 1% of precipitation), a 100-fold change in the runoff across the state. These two figures demonstrate the variations in moisture levels and how significantly different the levels can be across Kansas, thus affecting the drought conditions.

Figure 3.21. Kansas Precipitation-2008

KANSAS PRECIPITATION - 2008
Upper figure, 2008 Total; Lower Figure, 1971-2000 Average;
Inches of Water



2008 DISTRICT PRECIPITATION TOTALS (PRELIMINARY)

	NW	WC	SW	NC	C	SC	NE	EC	SE	STATE
2008 Average	24.58	21.93	17.94	35.68	34.10	36.34	40.26	42.98	56.28	34.37
Departure from Normal	+2.92	+1.27	-1.90	+8.20	+4.70	+7.68	+3.99	+5.44	+15.67	+5.50
% of Normal	113	106	90	130	116	127	111	114	139	119

More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences

Kansas has had recurring periods of drought throughout history, some of them lasting for very long extended periods. As shown in Figure 3.15, Kansas was in severe or extreme drought between 10 and 20% of the last century. During this time, perhaps the most notorious drought was during the Dust Bowl years of the 1930s. During the past century, several major and numerous minor droughts affected Kansas. All regions of Kansas have been subject to drought of varying levels of severity and duration since 1999. Table 3.25 summarizes Kansas county drought declarations made by the governor between 2002 and 2010.

Table 3.25. Kansas Drought Stage Declaration Summary 2000–2010

Date	Executive Order	Emergency	Warning	Watch	Total Counties
5/14/2007	07-13[5]	0	0	0	0
3/06/2007	07-04	0	3	57	60
8/21/2006	06-09	0	105	0	105
3/20/2006	06-04	0	80	25	105
2/07/2006	06-03	0	6	66	69
9/08/2004	04-09	0	6	9	15
6/15/2004	04-08	31	12	14	57
10/27/2003	03-22	28	77	0	105
8/22/2003	03-19	11	0	0	105[4]
8/22/2003	03-18	0	94	0	
7/31/2003	03-16[3]	0	0	52	105[4]
7/31/2003	03-15[3]	0	53	0	
7/30/2002		0	83	22	105
7/03/2002		0	61	0	61
5/03/2002		0	0	41	41
7/12/2000				UREP and SOL[2]	
6/09/2000				KLR and MO[2]	

Source: Kansas Water Office, www.kwo.org/Reports%20&%20Publications/Drought/Tbl_drought_declarations_051107_twl.pdf
1. No declarations were made in 2001 or 2005
2. Declarations issued for river basins rather than counties
3. First declarations under phased, three-stage response per Governor's Drought Response Team Operations Plan
4. Total counties declared under all Executive Orders on that date
5. EO 07-13 rescinds all county drought stages declared on 03/06/2007.
6. Information for 2007 – 2010 can be found on pages 3.57 and 3.58.

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies. The database is being populated beginning with the most recent impacts and working backward in time.

The Drought Impact Reporter contains information on 180 drought impacts from droughts that affected Kansas between January 1932 and January 2010. The list is not comprehensive. Eighty-one percent of the impacts are between 2000 and 2007 (although some impacts are from the droughts in the 1930s, 1950s, and late 1980s); 83% of them are from media reports. Most of the impacts, 66, were classified as "agriculture." Other impacts include "water/energy" (23), "social" (7), "fire" (14), "environment" (15), and "other" (20). These categories are described as follows:

- **Agriculture**—Impacts associated with agriculture, farming, and ranching. Examples include damage to crop quality, income loss for farmers because of reduced crop yields, reduced productivity of cropland, insect infestation, plant disease, increased irrigation costs, cost of new or supplemental water resource development, reduced productivity of rangeland, forced reduction of foundation stock, closure/limitation of public lands to grazing, high cost/unavailability of water for livestock, and range fires.

- **Water/Energy**—Impacts associated with surface or subsurface water supplies (i.e., reservoirs or aquifers), stream levels or streamflow, hydropower generation, or navigation. Examples include lower water levels in reservoirs, lakes, and ponds; reduced flow from springs; reduced streamflow; loss of wetlands; estuarine impacts; increased groundwater depletion, land subsidence, reduced recharge; water quality effects; revenue shortfalls and/or windfall profits; cost of water transport or transfer; cost of new or supplemental water resource development; and loss from impaired navigability of streams, rivers, and canals.
- **Environment**—Impacts associated with wildlife, fisheries, forests, and other fauna. Examples include loss of biodiversity of plants or wildlife; loss of trees from urban landscapes, shelterbelts, wooded conservation areas; reduction and degradation of fish and wildlife habitat; lack of feed and drinking water; greater mortality because of increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion; disease; increased vulnerability to predation; migration and concentration; and increased stress to endangered species.
- **Fire**—Impacts associated with forest and range fires that occur during drought events. The relationship between fires and droughts is very complex. Not all fires are caused by droughts and serious fires can result when droughts are not taking place.
- **Social**—Impacts associated with the public, or the recreation/tourism sector. Examples include health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced fire fighting capability, etc.), loss of human life (e.g., from heat stress, suicides), public safety from forest and range fires, increased respiratory ailments; increased disease caused by wildlife concentrations, population migrations, loss of aesthetic values; reduction or modification of recreational activities, losses to manufacturers and sellers of recreational equipment, and losses related to curtailed activities.
- **Other**—Drought impacts that do not easily fit into any of the above categories.

2007 – 2010 Drought Information

During the period of July 1, 2007 through June 1, 2010, periods of abnormal to extreme drought conditions were reported in the western two-thirds of the state. Normal to abnormally dry conditions were present throughout the Western and South Central regions by mid October. By the end of 2007, this changed to moderately dry conditions in the extreme Southwestern counties.

By late April 2008, conditions in this area had changed to the severe level and reached extreme levels by May 27. On June 11, as recommended by Tracy Streeter, Director of the Kansas Water Office and Chair of the Governor's Drought Response Team Governor Kathleen Sebelius declared drought warnings and watches in 13 Kansas counties, via Executive Order 08-07. Under drought warnings were the following counties: Grant, Hamilton, Morton, Stanton and Stevens. Under a drought watch were the following counties: Finney, Greeley, Haskell, Kearney, Meade, Scott, Seward and Wichita. The Executive Order was lifted 60 days later on August 10, but was renewed on August 22 although Hamilton was taken out of the warning and placed into the watch area. Finney and Scott were taken off the watch list. On August 2, the USDA issued an order implementing approval for emergency haying and grazing on Conservation Reserve Program (CRP) lands within the counties of Grant, Greeley, Hamilton, Haskell, Sherman, Stanton, Stevens and Wallace. Other major impacts of this drought period included decreased grain yields and lower wildlife survival rates. By August 26, the drought level returned to a moderate rating and from the end of October through December 30, levels were upgraded to abnormally dry.

By the end of February 2009, the Southwestern and South Central counties were downgraded to a moderate rating, but by the end of March the level was upgraded to abnormally dry. This area grew to encompass the entire western two-thirds of the state. This rating persisted until April, when the abnormally dry conditions moved into North Central and Central Kansas. These conditions remained in roughly the same areas until late September. Between this time and the end of 2009, conditions were upgraded to a normal state.

From January through mid-April of 2010, the state remained in a normal condition. Between April 13 and May 26, the South Central portion of the state downgraded to abnormally dry, but has since recovered to normal. As of June 1, 2010 the entire state is under normal drought conditions.

A total of 35 drought related impacts were reported in Kansas during this time period, including: 12 agricultural, 4 fire, 3 water/energy, 2 environmental and 14 other.

According to the Kansas Water Office *Kansas Drought Report and Climate Summary, April 2010*, the latest Drought Outlook does not indicate expectation of developing drought conditions.

October 2006

Kansas also experienced drought conditions in 2006. In October 2006, the U.S. Department of Agriculture designated 57 Kansas counties primary natural disaster areas because of losses caused by the combined effects of various disasters that occurred during the past year, including a late spring freeze, drought, high winds, and extreme temperatures. Eighteen contiguous counties were also eligible for assistance. Earlier that year, in June, Cherokee and Morton Counties were designated as primary disaster areas because of losses caused by drought, high winds, wildfires, and above normal temperatures. Contiguous counties Crawford, Labette, Stanton, and Stevens were also eligible for assistance. Two declarations in 2007 for 2006 made 15 more counties eligible for assistance as primary natural disaster areas and 19 more as contiguous counties. Provisional streamflow data from the U.S. Geological Survey indicated that several long-term low streamflow records were broken in July.

May 4, 2002–October 1, 2003

Beginning on May 4, 2002, the Palmer Drought Severity Index (PDSI) reached -2.5 in the northwest and southwest districts of the state and remained below that value, triggering activation of the Governor's Drought Response Team. At its worst in 2002, the PDSI was below -3.0 in six of nine meteorological districts. In 2002, rainfall was less than the Dust Bowl years in some parts of western Kansas. Lakes decreased significantly in size and ground water levels dropped. Low water in the Missouri River interfered with river barge traffic and necessitated the release of water from Milford, Tuttle Creek, and Perry Lakes.

This drought caused many counties to impose water use restrictions and burn bans. Grazing was prohibited on government lands to protect the drought-stressed grass, affecting thousands of cattle. Emergency haying and grazing was allowed by the U.S. Department of Agriculture (USDA) on Conservation Reserve Program lands. All 105 counties were eligible for federal assistance through the U.S. Department of Agriculture (USDA). The drought had a $1.1 billion impact on crop production.

2001

The Small Business Administration made economic injury disaster loans available in seventeen counties because of drought impacts.

The U.S. Supreme Court ruled that Colorado owed Kansas $29 million in damages and interest for depleting the Arkansas River. For years, Colorado farmers dug wells that diverted millions of gallons of Arkansas River water to their fields, reducing the availability of water for Kansans.

1988–1992

The severity of this drought varied across the state. It was most severe in the southwestern, central, and northeastern parts of the state but minimal in the northwestern and southeastern parts. Surface-water supplies were sufficient to meet demands through the end of water year 1988, but rainfall during this period was less than 50% of the long-term average, so quantities were insufficient to maintain soil moisture or contribute to ground-water supplies. Estimated drought-related losses to 1988 crops were $1 billion. Water levels in shallow aquifers declined rapidly and led to the abandonment of many domestic water wells. The drought of 1988 continued into the 1990s, but at a reduced level.

1974–1982

This appeared to be a series of relatively short droughts at some stream gauging stations, but longer droughts at others (similar to the 1962–1972 droughts). The recurrence interval of this drought was greater than 25 years in the north-central and southeastern parts but was between 10 and 25 years across the remaining eastern two-thirds of the state. The severity of this drought could not be determined for the western third of the state.

1962–1972

The duration of this regional drought varied considerably across Kansas. Many of the streamflow records indicated alternating less than average and greater-than-average flows, while others indicated less than average flows for the entire period. The recurrence interval was generally greater than 25 years but was between 10 and 25 years in parts of the northwestern, northeastern, southern, and southeastern areas of the state.

1952–1957

This regional drought had a recurrence interval greater than 25 years statewide. One exception was in the Big Blue River Basin, where the recurrence interval was 10-25 years. Because of its severity and areal extent, this drought is used as the base period for studies of reservoir yields in Kansas. In 1954, 41 counties were declared eligible for aid under the Emergency Feed program. During this period, 175 cities reported water shortages, most of which restricted water use.

1929–1942

This drought, which includes the Dust Bowl of the 1930s, was regional in scale and affected many of the Midwestern and western states. Nevertheless, it ranks among the most significant national events of the twentieth century. The recurrence interval was greater than 25 years throughout Kansas. Drought, wind, and poor agricultural practices combined to result in enormous soil erosion. Agricultural losses were extreme, and many farms were abandoned. Effects of the drought sent economic and social ripples throughout the country, contributing to the economic, physical, and emotional hardships of the Great Depression.

Figure 3.22 illustrates the extent of the Dust Bowl as defined by the Soil Conservation Service.

Figure 3.22. Extent of the Dust Bowl

Source: Public Broadcasting System American Experience "Surviving the Dust Bowl" www.pbs.org/wgbh/amex/dustbowl/maps/index.html

Local Plan Integration:

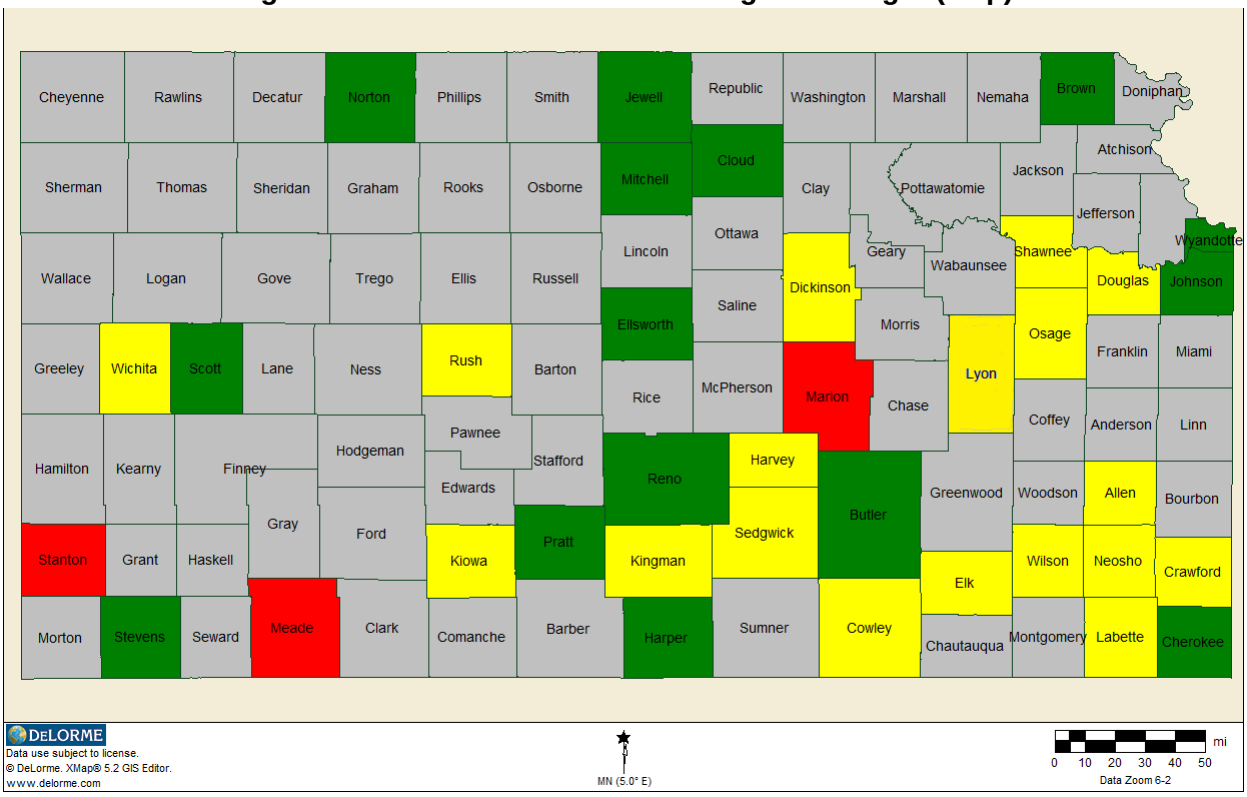
For the 2010 update, the committee reviewed the data from all FEMA-approved hazard mitigation plans in the State of Kansas. Shown in Table 3.26 is all information found in the local plans. Note that not all plans had information for this hazard:

Table 3.26. Local Plan Statistics for Drought

County	Plan Ranking	# of Events	Damages (Crop)
Allen	Moderate	N/A	N/A
Brown	Low	4	N/A
Butler	Low	1	N/A
Chase	N/A	N/A	N/A
Cherokee	Low	6	N/A
Cloud	Low	4	N/A
Cowley	Moderate	5	N/A
Crawford	Moderate	N/A	N/A
Dickinson	Moderate	N/A	$2,185,899.00
Douglas	Moderate	6	N/A
Elk	Moderate	2	$325,819.00
Ellsworth	Low	0	N/A
Harper	Low	N/A	$4,732,472.00
Harvey	Moderate	5	$851,816.00
Jewell	Low	2	$120,000,000.00
Johnson	Low	N/A	$161,352.00
Kingman	Moderate	N/A	N/A
Kiowa	Moderate	3	N/A
Labette	Moderate	N/A	$1,250,768.00
Linn	N/A	N/A	N/A

County	Plan Ranking	# of Events	Damages (Crop)
Lyon	Moderate	4	N/A
Marion	High	N/A	N/A
Meade	High	N/A	N/A
Miami	N/A	N/A	N/A
Mitchell	Low	N/A	N/A
Montgomery	N/A	N/A	N/A
Neosho	Moderate	3	$1,767,040.00
Norton	Low	6	N/A
Osage	Moderate	3	$1,309,543.00
Pratt	Low	N/A	N/A
Reno	Low	N/A	$8,744,468.00
Rush	Moderate	N/A	$2,802,847.00
Scott	Low	N/A	N/A
Sedgwick	Moderate	5	N/A
Shawnee	Low	N/A	N/A
Stanton	High	3	$5,420,228.00
Stevens	Low	N/A	N/A
Wichita	Moderate	N/A	N/A
Wilson	Moderate	8	$1,054,275.00
Wyandotte	Low	6	$27,252.00
Totals		76	$150,633,779

Figure 3.23. Local Plan Hazard Rating for Drought (Map)



Source: Bold Planning Solutions

Red – High Risk Rating – 3 Jurisdictions
Yellow – Moderate Risk Rating – 18 Jurisdictions
Green – Low Risk Rating – 15 Jurisdictions
Gray – No Plan or No Rating – 69 Jurisdictions

After reviewing the data in the local plan data table, the committee calculated the following estimates for droughts in the State of Kansas:

Table 3.27. Local Plan Averages for Drought

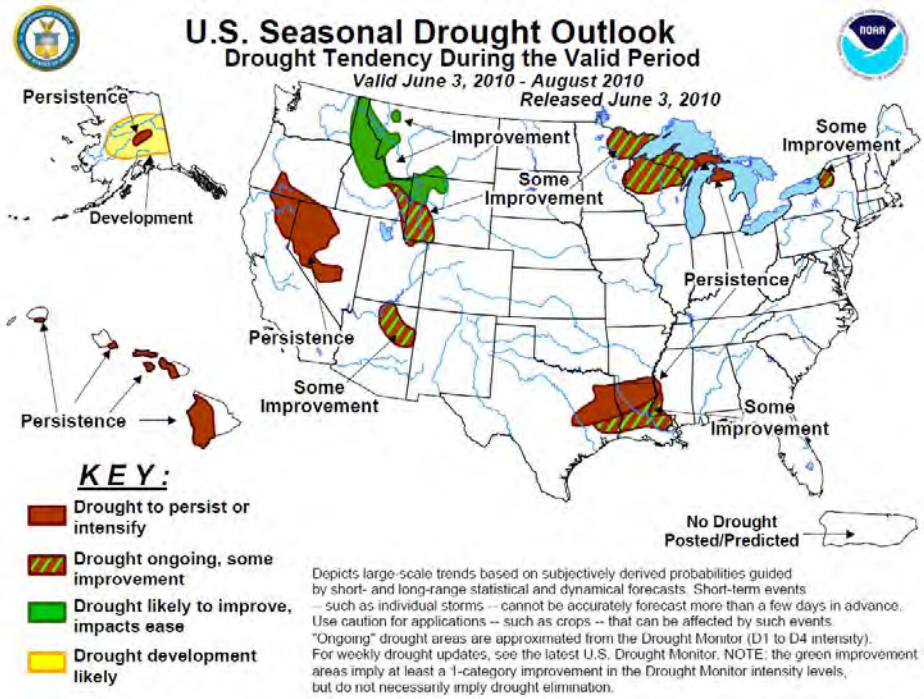
	Events	Total Damages
Totals	76	$150,633,779
Average per County	1.9	$3,765,844
Average Per Event		$1,982,023

According to this data, the average loss from a drought event in Kansas is $1,982,023. Since not all plans gather their data from the same period of years, an annual average cannot be calculated for damages and events per year in Kansas. A mitigation action item will be assessed to implement a drought date strategy for the next mitigation plan update (Version 5)

Probability

Based on historical drought declarations, (17 declarations in 7 years), and NCDC historical data, (23 events over a 23 year period), the State of Kansas can expect a drought occurrence every calendar year. This hazard's CPRI probability is "**Highly Likely**" (probable within the calendar year).

Figure 3.24.U.S. Seasonal Drought Outlook June 3, 2010



Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Drought	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year.		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years	x	
	Event has up to 1 in 5 years chance of occurring (1/5=20%)	x	
	History of events is greater than 10% but less than or equal to 20% likely per year	x	
	Event could "Possibly" occur	x	
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

While the entire state is moderately susceptible to drought, some jurisdictions may be more at risk from drought based on such factors as the adequacy of their water supply system, dependence on agriculture, the potential adverse affects to nearby navigation and water-based recreation, and vulnerability to drought-related hazards such as wildfire and wind erosion. Determining the direct and indirect costs associated with droughts is difficult because of the broad impacts of drought and the difficulty in establishing when droughts begin and end. As risk assessments from local mitigation plans become available, the estimated risk to individual counties from drought can be more accurately documented.

Drought can severely challenge a public water supplier through depletion of the raw water supply and greatly increased customer water demand. Even if the raw water supply remains adequate, problems due to limited treatment capacity or limited distribution system capacity may be encountered. A 2007 assessment of 800 city or rural water district drinking water systems by the Kansas Water Office found 133 to be drought vulnerable. They are listed in Table 3.28. Basic source limitations were the most common cause of drought vulnerability, followed by distribution system limitations. The most vulnerable basin is the Solomon Basin, where 42% of the basin's public water suppliers are considered by the state to be vulnerable to drought. Table 3.28 is a list of Public Water Suppliers Vulnerable to drought.

Table 3.28. Kansas Drought Vulnerable Public Water Suppliers

Supplier Name	County	2000 List	Limitation Category*
Lower Arkansas Basin			
Arlington	Reno	no	Basic Source
Attica	Harper	no	Basic Source
Bluff City	Harper	yes	Singe Well Source
Burrton	Harvey	no	Basic Source, Distribution System
Derby (El Paso WC)	Sedgwick	no	Distribution System
Goddard	Sedgwick	no	Distribution System
Hesston	Harvey	no	Basic Source, Water Right
Inman	McPherson	no	Basic Source
Lyons	Rice	no	Unknown
Pratt	Pratt	no	Unknown
Sedgwick RWD 02	Sedgwick	yes	Contractual
Sumner RWD 04	Sumner	yes	Contractual
Zenda	Kingman	yes	Single Well Source
Upper Arkansas Basin			
Alexander	Rush	no	Unknown
Dodge City	Ford	no	Distribution System
Ensign	Gray	no	Distribution System
Kinsley	Edwards	no	Unknown
Lakin	Kearney	no	Basic Source
Ness City	Ness	no	Unknown
Syracuse	Hamilton	no	Unknown
Cimarron Basin			
Coldwater	Comanche	no	Basic Source
Copeland	Gray	yes	Water Right
Englewood	Clark	no	Single Well Source

Hugoton	Stevens	no	Distribution System
Liberal	Seward	no	Basic Source
Montezuma	Gray	no	Basic Source, Distribution System
Moscow	Stevens	no	Basic Source
Rolla	Morton	no	Unknown
Kansas-Lower Republican Basin			
Clay RWD 01	Clay	yes	Minimum Desirable Streamflow, Single Well Source
Corning	Nemaha	yes	Distribution System
Easton	Leavenworth	yes	Basic Source
Frankfort	Marshall	yes	Basic Source
Geary RWD 02	Geary	yes	Single Well Source
Hanover	Washington	no	Distribution System
Jackson RWD 01	Jackson	no	Unknown
Jefferson RWD 09	Jefferson	no	Unknown
Kickapoo Tribe	Brown	yes	Basic Source
Leavenworth RWD 07	Leavenworth	yes	Contractual
Marysville	Marshall	no	Distribution System
McFarland	Wabaunsee	no	Basic Source
Morganville	Clay	yes	Basic Source
Nemaha RWD 03	Nemaha	yes	Distribution System
Pottawatomie RWD 01	Pottawatomie	no	Basic Source
Randall	Jewell	no	Unknown
St. George	Pottawatomie	no	Basic Source
Shawnee RWD 04C	Shawnee	no	Unknown
Tonganoxie	Leavenworth	no	Contractual
Valley Falls	Jefferson	yes	Basic Source
Washington RWD 02	Washington	no	Unknown
Marais des Cygnes Basin			
Baldwin City	Douglas	no	Contractual, Treatment Capacity
Bourbon RWD 02C	Bourbon	no	Distribution System
Fontana	Miami	yes	Basic Source, Single Well Source
Franklin RWD 01	Franklin	no	Contractual
Fulton	Bourbon	no	Unknown
Linn RWD 02	Linn	yes	Basic Source
Louisburg	Miami	no	Treatment Capacity
Osage RWD 02	Osage	no	Basic Source, Distribution System
Pleasanton	Linn	yes	Basic Source
Uniontown	Bourbon	no	Unknown
Wellsville	Franklin	no	Distribution System
Missouri Basin			
Nemaha RWD 01	Nemaha	no	Basic Source
Sabetha	Nemaha	no	Basic Source
Seneca	Nemaha	no	Basic Source, Distribution System
Neosho Basin			
Cedar Point	Chase	yes	Single Well Source
Peabody	Marion	no	Unknown
White City	Morris	no	Basic Source
Upper Republican Basin			

McDonald	Rawlins	no	Water Right
Norton	Norton	no	Unknown
Oberlin	Decatur	yes	Basic Source
Smoky Hill-Saline Basin			
Abilene	Dickinson	no	Basic Source
Bunker Hill	Russell	no	Single Well Source
Chapman	Dickinson	no	Unknown
Dickinson RWD 01	Dickinson	no	Basic Source
Dickinson RWD 02	Dickinson	no	Basic Source
Ellis	Ellis	no	Distribution System
Ellis RWD 03	Ellis	no	Basic Source
Ellsworth	Ellsworth	no	Minimum Desirable Streamflow
Gove	Gove	yes	Basic Source, Distribution System
Grainfield	Gove	no	Water Right
Grinnell	Gove	no	Water Right
Hays	Ellis	yes	Basic Source
Kanopolis	Ellsworth	yes	Basic Source
Lane RWD 01	Lane	no	Water Right
Lincoln	Lincoln	no	Basic Source
Lindsborg	McPherson	no	Basic Source
Manchester	Dickinson	no	Unknown
Oakley	Logan	no	Unknown
Palco	Rooks	no	Basic Source
Park	Gove	no	Basic Source
Ransom	Ness	no	Basic Source
Rooks RWD 02	Rooks	yes	Single Well Source
Russell	Russell	yes	Basic Source, Treatment Capacity
Russell RWD 02	Russell	yes	Single Well Source
Russell RWD 03	Russell	yes	Distribution System, Water Right
Salina	Saline	no	Basic Source
Susank	Barton	yes	Basic Source, Distribution System
Tescott	Ottawa	yes	Basic Source
Wallace	Wallace	yes	Water Right, Single Well Source
Wallace RWD 01	Wallace	yes	Single Well Source
Solomon Basin			
Alton	Osborne	no	Basic Source, Minimum Desirable Streamflow
Beloit	Mitchell	no	Unknown
Damar	Rooks	no	Contractual, Distribution System
Delphos	Ottawa	no	Basic Source
Downs	Osborne	yes	Basic Source
Esbon	Jewell	no	Unknown
Glen Elder	Mitchell	no	Unknown
Hill City	Graham	no	Unknown
Hoxie	Sheridan	yes	Basic Source
Logan	Phillips	yes	Basic Source
Morland	Graham	no	Unknown
Norton RWD 01	Norton	yes	Single Well Source
Osborne	Osborne	no	Basic Source

Palco	Rooks	no	Distribution System
Phillipsburg	Phillips	no	Treatment Capacity
Prairie View	Phillips	no	Unknown
Rexford	Thomas	no	Unknown
Smith Center	Smith	yes	Basic Source
Stockton	Rooks	no	Basic Source
Tipton	Mitchell	no	Unknown
Verdigris Basin			
Cedar Vale	Chautauqua	yes	Basic Source
Grenola	Elk	yes	Basic Source
Hamilton	Greenwood	no	Unknown
Longton	Elk	yes	Basic Source
Madison	Greenwood	no	Basic Source
Neodesha	Wilson	no	Unknown
Wilson RWD 01	Wilson	yes	Contractual
Wilson RWD 02	Wilson	yes	Contractual
Wilson RWD 05	Wilson	yes	Contractual
Wilson RWD 07	Wilson	yes	Contractual
Walnut Basin			
Butler RWD 04	Butler	yes	Contractual
Cambridge	Cowley	yes	Contractual
Dexter	Cowley	yes	Contractual
Leon	Butler	no	Basic Source

Source: Kansas Water Office

* Drought Limitation Categories

Basic Source Limitation—The supplier's primary raw water source is particularly sensitive to drought as evidenced by depleted streamflow, depleted reservoir inflow and storage, or by declining water levels in wells. Restrictions imposed due to inability to use a well(s) because water quality problems were considered indicative of a basic source limitation.

Contractual Limitation—The supplier's sole water source is purchased from another system that is drought vulnerable and there is a drought-cut-off clause in their water purchase contract. In such situations where there is not a drought cut-off clause, the purchaser is considered drought vulnerable under the same limitation category as the seller.

Distribution System Limitation—The supplier has difficulty or is unable to meet drought-induced customer demand for water because of inadequate finished water storage capacity, inadequate finished water pumping capacity, inadequate transmission line sizes, etc.

Minimum Desirable Streamflow—The supplier reported imposing restrictions because of minimum desirable streamflow administration. Water rights junior to those granted for maintenance of established minimum desirable flows are subject to such administration.

Single Well Source—The supplier relies upon a single well as its sole source for raw water. Suppliers with one active well and one emergency well were considered drought vulnerable because emergency wells are not a dependable long-term water source. Excessive hours of operation to meet drought-induced customer demand for water will result in the increased likelihood of mechanical breakdown with no alternative water supply source available.

Treatment Capacity Limitation—The supplier has difficulty or is unable to meet drought-induced customer demand for water due to inadequate raw water treatment capacity.

Water Right Limitation—The supplier reported imposing restrictions because the quantity of water they are authorized to divert under their water right(s) was insufficient to meet customer demands.

A comparison of the 2006 list with a list compiled in 2000 indicated an increase in the number of drought vulnerable suppliers in the most western basins and substantial declines in the number of suppliers in the Kansas-Lower Republican, Verdigris, and Walnut basins. The changes are attributed to the tapping of more reliable water sources through public wholesale water supply districts in eastern Kansas and the recent persistent drought conditions that exposed the true vulnerability of the suppliers in the western half of the state.

Development in Hazard-Prone Areas

Since drought affects the entire state and does not have geographic boundaries, this is not a significant issue of concern for mitigating drought. However, counties experiencing significant increases in population will create greater demands on water resources.

3.3.4 Earthquake

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
1.75	21 of 22	Low

Description
Kansas experiences small earthquakes on a routine basis, but few are of a magnitude that could cause damage to buildings or the infrastructure. According to a FEMA report, Kansas ranks 45th among the states in the amount of damage caused by earthquakes in an average year. The Kansas City, Missouri, area was ranked 35th among 35 major metropolitan areas.

Location
Overall, Kansas is in an area of relatively low seismic activity. According to the 2001 FEMA report, the most earthquake-prone part of the state is north-central Kansas, particularly Riley and Pottawatomie Counties. A series of faults called the Humboldt Fault Zone runs through this area and extends to the south along the Nemaha Ridge (also known as the Nemaha Uplift) (see Figure 3.25). A significant earthquake (the maximum credible earthquake in the area is a magnitude 6.6) in this area could result in the failure of Tuttle Creek dam (see Section 3.3.2 Dam and Levee Failure).Kansas is not expected to experience damaging shaking from a large New Madrid Seismic Zone event. The New Madrid Seismic Zone roughly follows the Mississippi River valley from southeastern Missouri to northwestern Mississippi. A large earthquake in this region could displace several thousand people and potentially lead to an influx into Kansas of victims fleeing the destruction.

Figure 3.25. Humboldt Fault Zone

Source: Kansas Geological Survey, Earthquakes in Kansas, www.kgs.ku.edu/Publications/GeoRecord/2001/vol7.3/Page1.html

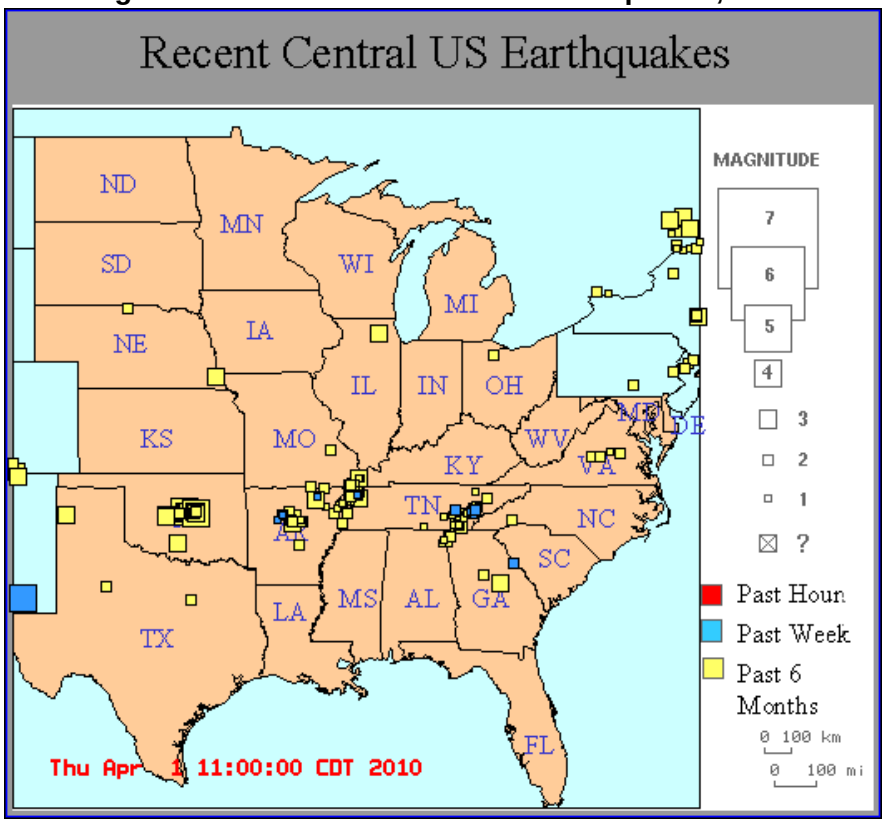
More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences

According to a FEMA report, the estimated annual loss from earthquakes in Kansas is $425,100, which includes capital and income-related costs.

At last count, there were more than 214 recorded or felt earthquakes since 1867. Most of these were small and did not cause significant damage and may not even have been felt. The earliest reported in Kansas, and also the strongest, occurred on April 24, 1867, in the Humboldt Fault zone near the town of Wamego. It had a magnitude of 5.5 and caused structural damage in Manhattan and minor damage in other nearby communities. There were several injuries and some damage as well as a two-foot wave on the Kansas River at Manhattan. The tremor was felt over a 300,000 square mile area in the Midwest. Figure 3.26 shows earthquakes in the Central United States over a six-month period in 2010.

Figure 3.26. Recent Central U.S. Earthquakes, 2010



Source: Center for Earthquake Research and Information, http://folkworm.ceri.memphis.edu/recenteqs

Other Earthquakes

- March 23, 2007—A 3.1 magnitude earthquake struck 15 miles west southwest of Atchison. It was felt at Atchison and Norton.
- July 24, 2001—A 3.0 magnitude earthquake in Butler County rattled computer screens at City Hall and shook several houses in Augusta. It occurred 24 miles above an area where

four stems of the main Humboldt Fault line lie. It caused minor damage and injuries and was felt as far away as Dubuque, Iowa.

- May 13, 1999—A 40-block section of Kansas City was shaken by a 3.0 magnitude earthquake. About 100 people evacuated from Indian Springs Medical Building, which was damaged in the earthquake. The epicenter was in Kansas.
- June 1989—A magnitude 4.0 earthquake shook Palco in Rooks County and did minor damage (this may have been human induced, e.g., mining-related).
- November 9, 1968—A 5.3 magnitude earthquake centered in southern Illinois was felt in eastern Kansas.
- April 13, 1961—With an epicenter in Kansas, this earthquake affected Norton County.
- January 6, 1956—This earthquake caused minor damage at Coats, Coldwater, Medicine Lodge, and Wilmore. The damage was limited to loosened bricks, cracked plaster and chimneys, and objects knocked from walls and shelves. Many observers reported being shaken from their beds by the shock.
- April 9, 1952—A damaging earthquake centered near El Reno, Oklahoma, affected a total area of 140,000 square miles, including all of the eastern half of Kansas. The magnitude 5.5 shock was felt in Kansas most strongly at Medicine Lodge. Kansas City was also strongly affected.
- February 20, 1933—A moderate earthquake was felt in Norton and Decatur Counties.
- Fall 1929—Four earthquakes with magnitudes between 3.2 and 4.2 occurred near Manhattan between September 23 and December 7, 1929.
- March 18, 1927– An earthquake near White Cloud, in the extreme northeastern portion of the state, rocked houses such that people rushed out of them.
- January 7, 1906— A magnitude 4.7 earthquake affected an area of about 10,000 square miles in Kansas, Missouri, and Nebraska. Chimneys were thrown down and some cracks in walls were observed at Manhattan. Houses and buildings vibrated at Topeka, where a loud roaring sound was also heard. A series of small aftershocks were felt in Manhattan.
- October 27, 1904—An earthquake shook the area around Dodge City and Meade, in western Kansas.
- October 31, 1895—This earthquake near Charleston, Missouri, affected a million square miles over 23 states. The strongest effects in Kansas were reported in Topeka.
- November 8, 1875—A moderate earthquake near Valley Falls north of Topeka was felt over 8,000 square miles but did little damage.

Probability

The risk from earthquakes in Kansas is relatively low, according to a report from the Federal Emergency Management Agency. However, earthquake risk is slightly higher in some parts of the state than others, according to geologists at the Kansas Geological Survey and the University of Kansas. The FEMA report, released Sept. 20, defines risk according to the average annual amount of damage caused to buildings by earthquakes.

Kansas is not considered to have a high risk of a major earthquake. Nevertheless, some risk does exist. As measured by peak acceleration, the area in north central and north eastern areas of the state are at higher risk than most of the rest of Kansas, which have very low potentials for an earthquake. Figures 3.26 and 3.27 are probabilistic seismic hazard maps of Kansas from the U.S. Geological Survey that depict the probability that ground motion will reach a certain level during an earthquake. The data shows peak horizontal ground acceleration (the fastest measured change in speed for a particle at ground level that is

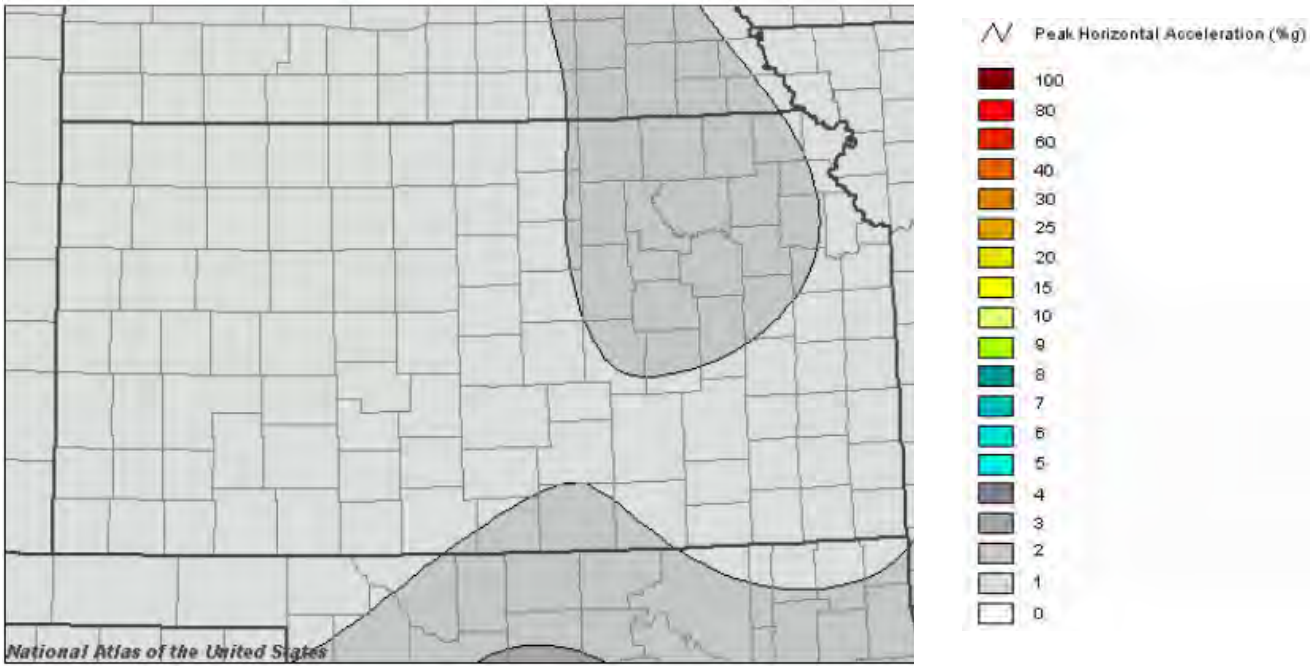
moving horizontally because of an earthquake). Figure 3.26 depicts the shaking level that has a 10% chance of being exceeded over a period of 50 years. Figure 3.27, which is more of a worst-case scenario, depicts the shaking level that has a 2% chance of being exceeded over a period of 50 years. Typically, significant earthquake damage occurs when accelerations are greater than 30% of gravity. This hazard's CPRI probability on a state-wide basis is "**Unlikely**" to occur in the next three years. Recognizing that there is a high hazard dam and that there have been two recorded earthquakes in the Manhattan, Kansas area in less than 100 years, local mitigation plans created around the Humboldt Fault Zone are encouraged to recognize the earthquake risk in their hazard analysis updates in the future. The most earthquake-prone part of the state is north-central Kansas, particularly Riley and Pottawatomie Counties.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

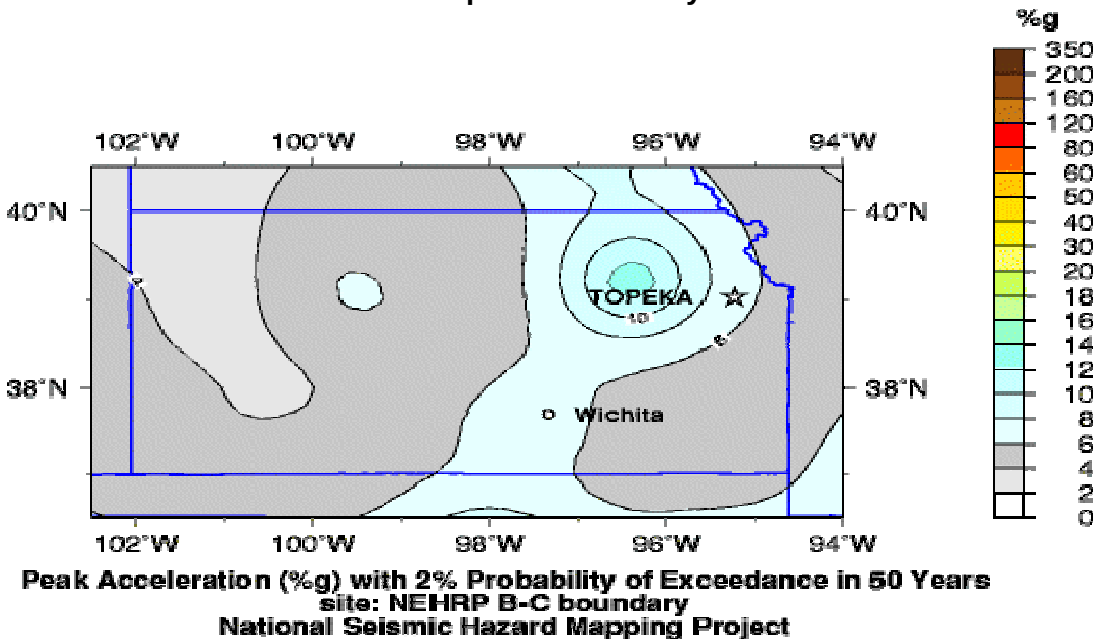
Hazard	Earthquake Event	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years	x	x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)	x	x
	History of events is less than or equal to 10% likely per year	x	x
	Event is "Unlikely" but is possible to occur	x	x

Figure 3.27. Kansas Seismic Hazard Map—10% Probability of Exceedance in 50 Years



Source: U.S. Geological Survey, map generated by National Atlas of the United States, www.nationalatlas.gov/

Figure 3.28 Kansas Seismic Hazard Map 2 % Probability of Exceedance in 50 Years



Source: U.S. Geological Survey Earthquake Hazards Program, http://earthquake.usgs.gov/regional/states/kansas/hazards.php

Vulnerability and Potential Losses by Jurisdiction

The counties that are at least partially in Kansas' highest zone of peak horizontal acceleration (for the 10% probability of exceedance in 50 years) are Atchison, Brown, Chase, Clay, Cloud, Dickinson, Douglas, Geary, Jackson, Jefferson, Lyon, Marion, Marshall, Morris, Nemaha, Osage, Ottawa, Pottawatomie, Republic, Riley, Saline, Shawnee, Wabaunsee, and Washington in the northeast and Barber, Cowley, Harper, and Sumner in the south. The level of shaking on USGS 10% and 2% probability of exceedance maps do not indicate ranges of shaking where significant damage would be experienced. Damage incurred would be primarily to contents and non-structural elements of buildings. A further estimation of losses was not done because of the low level of planning significance associated with this hazard.

Development in Hazard-Prone Areas

Growing counties in northeastern Kansas indicate that potentially more property and people will be at risk to earthquake shaking, particularly around the Manhattan area, which is experiencing the most development in the high-risk areas of the state, and is the location of one of the major universities in the state. Below is the current Risk-Ranking for the current Riley County, Kansas Mitigation plan (Manhattan area). As you can see, the overall earthquake risk ranking is still rated as "negligible." **Table 3.28**

(1) NATURAL HAZARDS PRIORITIZATION (High, Moderate, Low, Negligible)			
High Risk	Moderate Risk	Low Risk	Negligible Risk
Winter Storm	Excessive Heat		Earthquake
Hail	Tornado		
Wildfire	Drought		
TSTM Wind	Fog		
Flood	Terrorism / AT / CD		
	Dam/Levee		
	Utility Failure		

Riley County Risk Rating 2010

3.3.5 Expansive Soils

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.65	13 of 22	**Moderate**

Description

A relatively widespread geologic hazard for Kansas is the presence of soils that expand and shrink in relation to their water content. Expansive soils can cause physical damage to building foundations, roadways, and other components of the infrastructure when clay soils swell and shrink as a result of changes in moisture content. For Kansas, the vulnerability to this hazard most frequently is associated with soils shrinking during periods of drought.

Thirty-six states have expansive soils within their jurisdiction. Expansive soils are so extensive within parts of the United States that alteration of the highway routes to avoid expansive soils is virtually impossible. The Midwest is particularly problematic for construction because of the varied mixture of clay soils. Each year in the United States, expansive soils cause billions of dollars in damage to buildings, roads, pipelines, and other structures. This is more damage than that typically caused by floods, hurricanes, tornadoes, and earthquakes combined. It is estimated that approximately 10% of the homes built on expansive soils experience significant damage. Because there is limited available data on this hazard and no reported occurrences, the previous plan's assessment remains valid and will be applicable for the 2010 update.

Location

Expansive soils are a moderate risk that is largely uniform across the state. Related hazard events are correlated with periods of drought in eastern Kansas and heavy rainfall in western Kansas. However, developed and developing communities in Kansas in the areas of high clay content soils, which commonly experience fluctuations in the water table, are probably the most vulnerable to expansive soils. The distribution of clay soils is an indication of the extent of the vulnerability to this hazard in the state. As shown in Figure 3.28, nearly all of the state has clay containing soils with at least a slight potential for swelling and shrinking that could damage building foundations, roadways, and similar properties. The map indicates that the locations in the state with the soils having the higher swelling potential exist in the western and central counties.

Figure 3.29. Area of Kansas Vulnerable to Expansive Soils

MAP LEGEND

- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Unit contains abundant clay having slight to moderate swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay

Previous Occurrences

Streets and parking lots throughout the state are damaged every year by the effects of expansive soils. The frequency of damage from expansive soils can be associated with the cycles of drought and heavy rainfall, which reflect changes in moisture content. Building settlements associated with drought have been noted in Kansas for many years, particularly in buildings located on high ground, further from the water table.

There are no expansive soil events on record in the state of Kansas to date. There is some data pertaining to expansive soil events around Kansas City, MO. That information is detailed below.

1950 Expansive Soil Event - Many homes and buildings in the Kansas City metropolitan area experienced minor damage as a result of the 1950s' drought. Up to 65% of the homes were damaged at an estimated cost of $30-$40 million.

1985 Expansive Soil Event - movement in expansive shales caused damage to St. Teresa's Academy, the 7th Church of Christ, the Kansas City Public Library Country Club Plaza Branch, and the University Center at the University of Missouri, all in Kansas City, Missouri.

Probability

Based on the widespread distribution of soils and dry and wet cycles in Kansas, this hazard's CPRI probability (for a damaging swelling soils event) is "**Highly Likely**" within the next three years.

Data limitations for expansive soil events will be addressed as mitigation action items in the 2010 mitigation plan for the State of Kansas. Probability analysis may migrate as more data is derived at the state level.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Expansive Soils	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year.		x
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

No one has estimated the damages and losses from expansive soils in the state. Detailed maps are needed to help develop avoidance and mitigation strategies.

Development in Hazard-Prone Areas

While the presence of clays with high swelling and shrinking potential are somewhat higher in the western part of the state, development has not and is not occurring at a rate to cause structural damages from this hazard to increase the estimate of relative risk. Damage from expansive soil to new construction is often mitigated with modern construction practices.

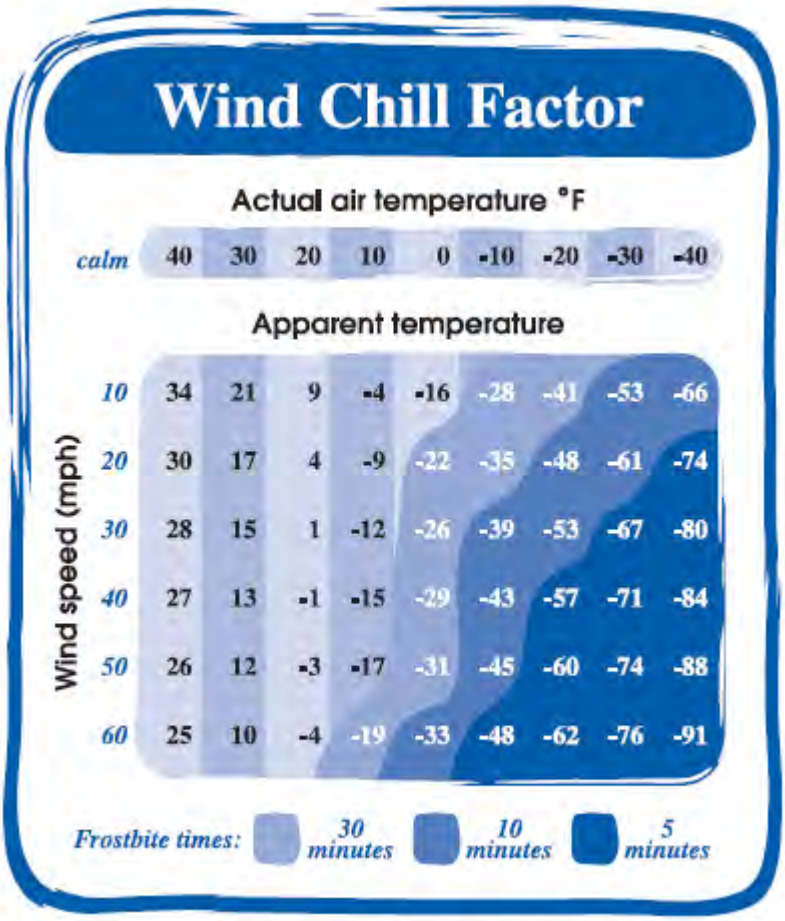
3.3.6 Extreme Temperatures

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.40	15 of 22	Moderate

Description

Heat waves and unusually cold weather are considered hazards in Kansas because of their deleterious effects on people, agriculture, the environment, infrastructure, and the economy. Heat waves can be closely associated with drought, while extreme low temperatures may be associated with winter storms or occur as separate atmospheric events. Unusually low temperatures outside of the typical cold months (e.g., early and late freezes) can be particularly damaging to crops.

Extreme Heat is defined by the Centers for Disease Control as "summertime temperatures that are substantially hotter or more humid than average for a location at that time of year. Increases in humidity make it more difficult for the body to cool itself as sweat does not evaporate as quickly, preventing the body from cooling.



National Weather Service (NWS) Wind Chill Chart adapted May 2004 from http://www.nws.noaa.gov/om/windchill/

According to the Centers for Disease Control and Prevention, 8,015 people died in the United States from excessive heat exposure between 1979 and 2003. During this period, more people in the United States died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined. Those at greatest risk for heat-related illness include infants and children up to four years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. Also, during extreme heat events, infrastructure, energy sources in particular, can be stressed, and long-term extreme heat can stress water sources, particularly

if occurring during a period of drought.

Extreme cold are those temperatures that are lower than normal for a given area with the increase in wind speed. The combination of these two elements affect the wind chill factor. The wind chill factor is the perceived temperature. As the speed of wind increases, the skin temperature drops as the heat is carried away from the body. As the perceived temperature increases, the risk of frostbite and hypothermia increases.

Extreme cold can cause hypothermia (an extreme lowering of the body's temperature), frostbite and death. Infants and the elderly are particularly at risk, but anyone can be affected. While there are no firm data on hypothermia (cold) death rates, it is estimated that 25,000 older adults die from hypothermia each year. The National Institute on Aging estimates that more than 2.5 million Americans are especially vulnerable to hypothermia, with the isolated elderly being most at risk. About 10% of people over the age of 65 have some kind of temperature-regulating defect, and 3-4% of all hospital patients over 65 are hypothermic. The heightened vulnerability of the elderly to hypothermia is of interest to Kansas, in light of the fact that the portion of the state's elderly population is slightly higher than the national average.

Also at risk are those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters; household fires, which can be caused by fireplaces and emergency heaters; and frozen/burst pipes.

More information can be found in Appendix T Kansas Extreme Heat Vulnerability.

Location

All of Kansas is susceptible to extreme temperatures. The heat risk to humans is generally uniform across the state but may be slightly higher in the east because of a relatively higher heat index.

Previous Occurrences

Since 1980, there were a number of major extreme temperature events that have caused death and damage in the Central United States, including Kansas. From June to September 1980, approximately 10,000 people died from heat-related conditions, and agricultural and related industries lost an estimated $44 billion in damages. During a 1988 heat wave in the central United States, between 5,000 and 10,000 lives were lost to the heat, and the toll on agriculture was $56 billion. In July 1995, more than 1,000 people died in the heat wave that hit the Midwest. There is no firm historical data on deaths or illnesses as a result of extreme temperatures in Kansas.

Recorded temperatures in Kansas as of May 1, 2004, have ranged from –40 degrees °F (Lebanon, February 1905) to 121 degrees °F (Alton, July 1934). Temperature extremes for each month are shown in Table 3.29. There have been no reported extreme heat events in the State of Kansas since 2006. Twelve deaths can be accredited to extreme heat conditions from 1998-2006. Details below:

Table 3.29 Recorded Kansas Extreme Heat Deaths 1998-2010

Year	Number of Deaths Accredited to Extreme Heat Events in the State of Kansas
1998	2
1999	2
2000	2
2001	0
2002	0
2003	0
2004	0
2005	1
2006	5
2007	0
2008	0
2009	0
2010	0
12 years Total	12 Deaths Total

The State of Kansas has experienced two extreme cold/wind chill events in 2009-2010. Their descriptions can be found below.

Table 3.30. Kansas Temperature Extremes

Month	Maximum °F	Year	Place	Minimum °F	Year	Place
January	88	1967	Kinsley	–35	1947	Centralia
February	92	1981	Aetna	–40	1905	Lebanon
March	100	1910	Hugoton	–25	1948	Oberlin*
April	107	1989	Hays	–2	1935	Dresden*
May	108	1939	Ellsworth*	14	1909	Wallace
June	116	1911	Clay Center*	30	1917	Irene*
July	121	1936	Alton*	32	1880	Unknown
August	119	1936	Wellington*	33	1910	St. Francis*
September	117	1947	Lincoln	15	1984	Kirwin Dam
October	104	1947	St. Francis	–3	1917	Wallace
November	96	1909	Kingman	–20	1887	Monument
December	90	1955	Ashland	–34	1989	Atwood

Source: Information Please Database, Pearson Education, Inc. www.infoplease.com/ipa/A0930179.html
* Also on earlier dates at the same time or other places.

Notable Extreme Temperature Events

- January 7, 2010 – An unusually cold Arctic air mass came across the area on January 6th and stayed through January 9th. This area has not seen a cold air mass like this since December 2005, and even February 1996 before that. Besides the cold temperatures, this Arctic air mass brought in very strong winds throughout the area on the evening of January

6th and on Thursday, January the 7th. The strong winds combined with the very cold temperatures creating dangerous wind chills. Wind chills through this cold outbreak created dangerous situations for people, animals, and property that were outdoors for a long period of time. Several schools across the area were cancelled or delayed, waterline mains burst and slick driving conditions were reported.

- December 9, 2009 – Wind chill values of -25 to -30 Fahrenheit were common on the morning of the 9th across all of northwest Kansas, southwest Nebraska and eastern Colorado. Air temperatures of -5 to -15 F combined with north winds to produce dangerously low wind chill readings.
- April 2007—The U.S. Department of Agriculture designated 68 Kansas counties primary natural disaster areas because of losses caused by unseasonably warm temperatures followed by prolonged freezing weather that occurred from April 4, 2007, through April 10, 2007. Fifteen contiguous counties were also eligible for assistance.
- July 16-20, 2006—From July 16-20, a deadly heat wave gripped much of central, south-central, and eastern Kansas. Temperatures soared into the 105-110 °F range. Five lives were lost across south-central and southeast Kansas: three in Wichita, one in Iola, and another in Coffeyville. The heat unofficially claimed three other lives, two in Wichita and one in Coffeyville, and dozens of people across central, south-central, and southeast Kansas were treated for heat-related illnesses. The same heat wave also caused two train derailments, which required rerouting of train traffic. The derailments were caused by “sun kinks”: the metal tracks expanded from the heat. One train derailed north of Topeka toward Atchison, and the other derailed immediately east of Neosho Rapids. The train that derailed near Neosho Rapids had five cars that contained hazardous materials; none of them was compromised. That same year, a late freeze damaged at least 75% of the wheat crop.
- July 2001—Several cities experienced many days in which temperatures exceeded 100 degrees F. The most number of days with such high temperatures occurred in Liberal, Dodge City, and Medicine Lodge where temperatures exceeded 100 degrees for 19, 20, and 21 days, respectively. There were difficulties meeting increased electrical demand because of the concurrent outage of a generating station. In the Wichita area, there were 17 days in July that reached 100 °F or higher, nine of which were consecutive.
- December 2000—Much of the state experienced below normal temperatures from mid-late December into January.
- August 2000—This August will be remembered as one of the hotter Augusts on record for north-central and northeastern Kansas. The last half of the month was especially hot with nearly all of the monthly highest temperatures reached during this time period. At least 14 people were treated for heat-related illnesses.
- July 1999—Excessive heat occurred over north-central and northeastern Kansas throughout the month, but during a two-week period at the end of the month, temperatures exceeded 100 °F in many areas on many days. Two deaths were attributed to the heat.
- August 17, 1998—Two high school football players, one in Butler County and one in Sedgwick County, suffered from heat stroke during practice and died the following morning.
- February 1996—Record setting to near record setting cold covered northeast and north-central Kansas from the 1st through the 4th. Daytime highs in some areas failed to reach zero. These readings were quite extreme and rare for the local area where little if any snow was on the ground during the coldest time. Low temperatures plunged to between 10 below and 20 below zero with wind chills of 40 below to 60 below zero. These extreme readings caused water pipes to burst, water meters to freeze, inoperative vehicles, overworked heating systems and a host of other problems associated with prolonged extreme cold. Most

schools, especially rural areas, cancelled classes while many businesses and activities were curtailed or cancelled.

- September 1995—The earliest freeze on record hit most of north-central and northeast Kansas causing widespread and heavy damage to immature crops. Damage likely exceeded $25 million.
- April 1995—Extreme cold damaged wheat in a critical growth stage in Greeley and Wichita Counties. Crop damage was estimated at $2.5 million.
- December 1983—In the Topeka area, an unprecedented cold spell set temperature records every morning from December 18 to 25. A deep snow cover kept temperatures at or below zero for a record-setting 95 consecutive hours from December 21 to 25. The lowest temperature of 17 degrees below zero occurred on December 22. Very strong winds accompanied the cold, producing deadly wind chill readings.
- July 1980—In the Wichita area, high temperatures cleared 100 °F 24 out of 31 days, including 18 consecutive days of 100 °F or higher. In the Topeka area, temperatures hit 100 °F or higher on 20 out of 31 days, with 12 consecutive days of 100 °F or higher.

Probability

Based on the 12 notable events within a 30-year time period (1980–2010), an extreme temperature event occurs every 2.5 years on average. This hazard's CPRI probability is "**Likely**" within the next three years. An extreme heat event is more likely to occur in the months of June, July, August, and September, and an extreme cold event is more likely to occur in the months of November, December, January, February, and March.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Extreme Temperatures	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years.	x	
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur	x	
2 - Possible	Event is probable within the next five years.		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x

Local Plan Integration

For the 2010 update, the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.31.

Table 3.31.Local Plan Integration for Extreme Temperatures

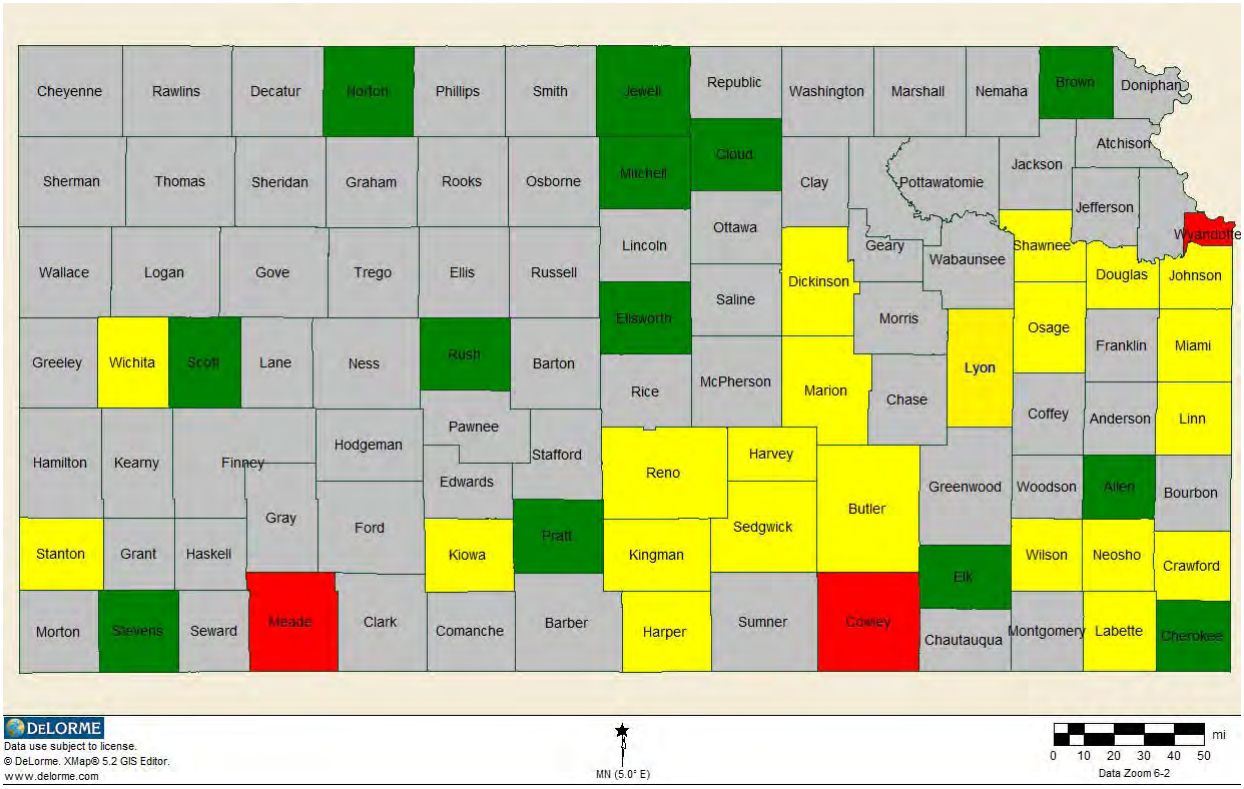
County	Region	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	Southeast	Low	N/A	N/A	N/A	N/A	5
Brown	Northeast	Low	9	N/A	N/A	N/A	N/A
Butler	South Central	Moderate	3	N/A	N/A	N/A	7
Chase	Northeast	Low	N/A	N/A	N/A	N/A	N/A
Cherokee	Southeast	Low	5	N/A	N/A	N/A	N/A
Cloud	North Central	Low	9	N/A	N/A	N/A	N/A
Cowley	South Central	High	1	N/A	N/A	N/A	N/A
Crawford	Southeast	Moderate	5	N/A	N/A	N/A	N/A
Dickinson	North Central	Moderate	16	N/A	N/A	N/A	N/A
Douglas	Northeast	Moderate	19	N/A	N/A	N/A	N/A
Elk	Southeast	Low	1	N/A	N/A	N/A	N/A
Ellsworth	North Central	Low	1	N/A	N/A	N/A	5
Harper	South Central	Moderate	1	N/A	$135,799.00	N/A	N/A
Harvey	South Central	Moderate	1	N/A	$65,649.00	N/A	N/A
Jewell	North Central	Low	N/A	N/A	N/A	N/A	N/A
Johnson	KC Metro	Moderate	18	N/A	$86,665.00	N/A	N/A
Kingman	South Central	Moderate	N/A	N/A	N/A	N/A	N/A
Kiowa	South Central	Moderate	N/A	N/A	N/A	N/A	N/A
Labette	Southeast	Moderate	1	N/A	$19,762.00	N/A	N/A
Linn	Northeast	Moderate	3	N/A	N/A	N/A	N/A
Lyon	Northeast	Moderate	11	$25,000,000.00	N/A	14	1
Marion	South Central	Moderate	N/A	N/A	N/A	N/A	N/A
Meade	Southwest	High	2	N/A	N/A	N/A	N/A
Miami	Northeast	Moderate	3	N/A	N/A	N/A	1
Mitchell	North Central	Low	N/A	N/A	N/A	N/A	N/A
Montgomery	Southeast	N/A	N/A	N/A	N/A	N/A	N/A
Neosho	Southeast	Moderate	1	N/A	$4,443.00	N/A	N/A
Norton	Northwest	Low	3	N/A	N/A	N/A	N/A
Osage	Northeast	Moderate	10	N/A	$127,724.00	N/A	N/A
Pratt	South Central	Low	N/A	N/A	N/A	N/A	N/A
Reno	South Central	Moderate	1	N/A	$686,569.00	N/A	N/A
Rush	Northwest	Low	2	N/A	$1,454,084.00	N/A	N/A
Scott	Southwest	Low	N/A	N/A	N/A	N/A	N/A
Sedgwick	South Central	Moderate	5	N/A	N/A	3	2
Shawnee	Northeast	Moderate	N/A	N/A	N/A	14	1
Stanton	Southwest	Moderate	2	N/A	$5,962,161.00	N/A	N/A
Stevens	Southwest	Low	N/A	N/A	N/A	N/A	N/A
Wichita	Southwest	Moderate	5	N/A	$2,500,000.00	N/A	N/A
Wilson	Southeast	Moderate	1	N/A	N/A	N/A	N/A
Wyandotte	KC Metro	High	18	N/A	$13,477.00	N/A	4
Totals			**146**	**$25,000,000**	**$11,056,333**	**29**	**26**

After reviewing the data from the local plans throughout the State of Kansas, the committee calculated averages for extreme temperatures. As shown in the table below, the state can expect an average of $246,961 in damages from a single extreme temperature event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.32. Local Plan Averages for Extreme Temperatures

	Deaths	Injuries	Total Damages
Totals	26	29	$36,056,333
Average per County	0.65	0.725	$901,408
Average Per Event	0.17	0.2	$246,961

Figure 3.30 Local Plan Hazard Rating for Extreme Temperatures (Map)



Source: Bold Planning Solutions

Red – High Risk Rating – 3 Jurisdictions

Yellow – Moderate Risk Rating – 22 Jurisdictions

Green – Low Risk Rating – 13 Jurisdictions

Gray – No Plan or Rating – 37 Jurisdictions

Vulnerability and Potential Losses by Jurisdiction

All Kansas communities are vulnerable to the impacts of extreme temperatures. However, those with a higher ratio of elderly may be more at risk because of the heightened vulnerability of this segment of the population. Figure 3.31 shows which counties have the largest elderly population (age 65 and up). Based on elderly populations there is greater risk to the more urban counties of Johnson, Wyandotte, Sedgwick and Shawnee, but overall the State of Kansas has a higher than average elderly population. This hazard can become more serious when combined with a utility/infrastructure failure or winter storm hazard. Sometimes this hazard contributes to the infrastructure failure, such as overloading of the power grid during hot summer months. Severe temperatures could impact the agriculture industry statewide.

Figure 3.31. Distribution of Elderly Population

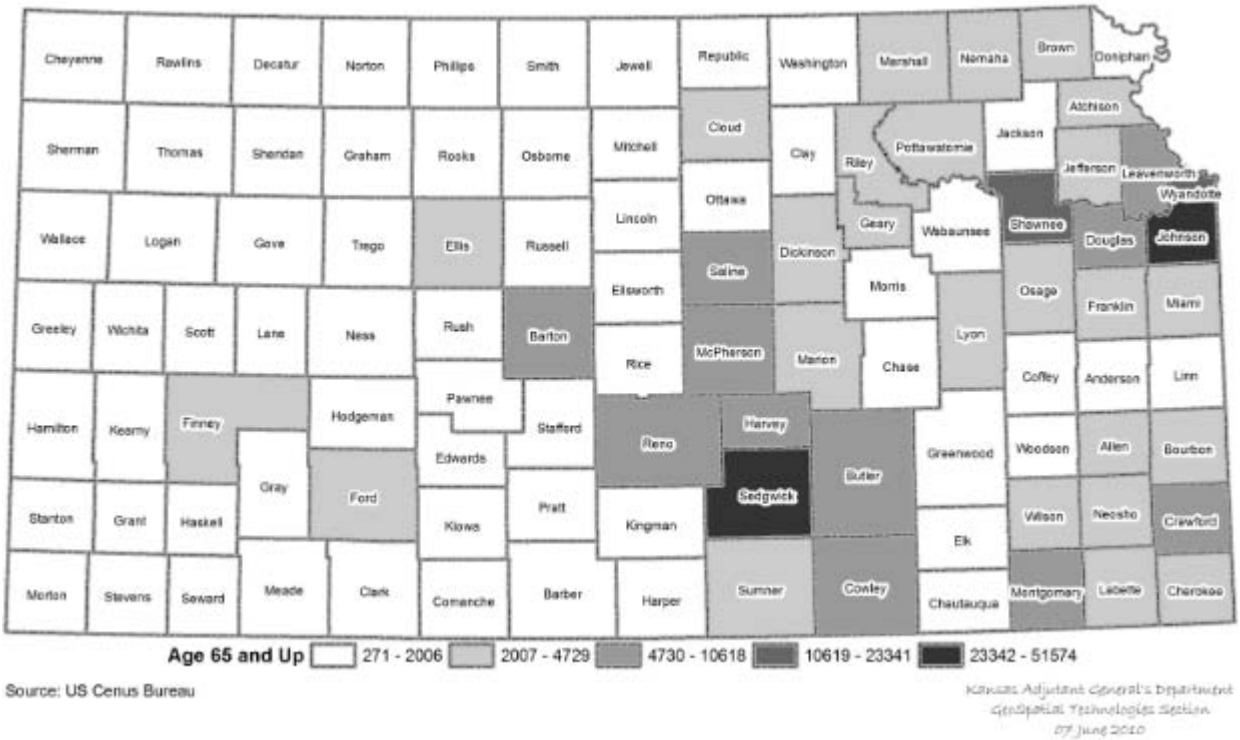


Figure 3.31.B Distribution of Elderly Population Projections Figures

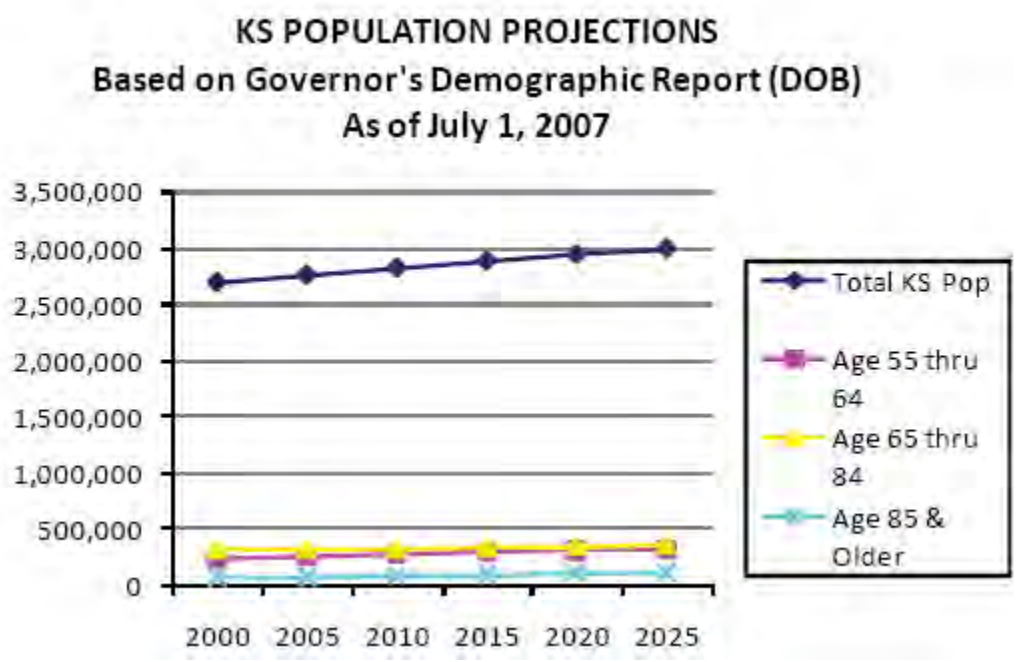
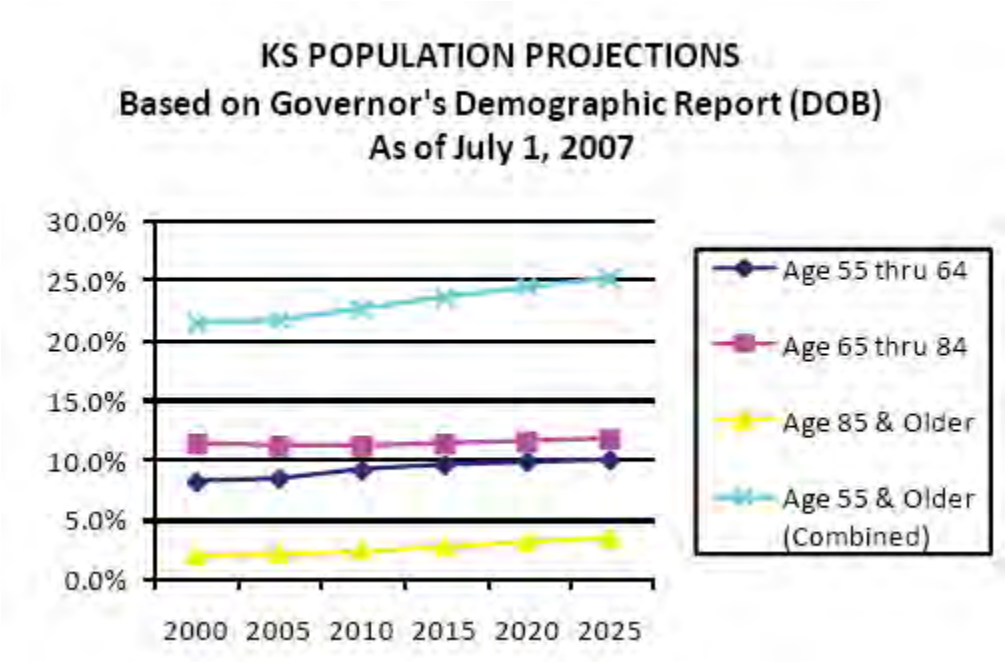


Figure 3.31.B Distribution of Elderly Population Projections %



Elderly Population and Extreme Temperatures Mitigation

The elderly population is considered during the mitigation project selection process in the State of Kansas. Natural disasters such as extreme temperatures can target the elderly population that suffers from disabilities and activity limitations as well as from poverty. Please reference Appendix O "Kansas State Plan on Aging" 2010 – 2013. This plan details mitigation actions currently managed by the Kansas Department of Aging to minimize risk exposure to the elderly population in the state.

Based on the notable temperature events between 1980 and 2010, there have been 12 lives lost and 14 injuries related to extreme temperatures. There has been an estimated average of one million dollars in losses during this period.

Development in Hazard-Prone Areas

Since extreme temperatures affect the entire state, this is not a significant issue of concern for mitigating extreme temperatures.

3.3.7 Flood

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.45	1 of 22	**High**

Description

During the twentieth century, floods were the leading natural disaster in the United States, representing 40% of all natural disasters in terms of number of lives lost and property damage. The U.S. Geological Survey reports that, nationwide, floods kill an average of 140 people each year and cause $6 billion in property damage.

Floods, while generally caused by the accumulation of too much water in too little time in too small an area, can be divided into several types, such as riverine, flash, ice-jam, storm-surge, and dam and levee failure floods. Warning time can range from a few seconds to months, and the duration can last from hours to weeks—or even months in the case of the 1993 flood.

Riverine flooding is the most common type of flood hazard in Kansas. In this case, when a stream channel fills with more water than it can carry, water rises and flows over the banks onto the adjacent floodplain. Persistent wet meteorological patterns are usually responsible for very large regional floods, such as the Mississippi River Basin flood of 1993 when about 40 inches of rain fell during the first seven months of the year in northeast Kansas.

Kansas is also prone to flash flooding, which is defined as a rapid rise in water level, fast-moving water, and debris. This is an increasingly serious problem due to removal of vegetation, paving, replacement of ground cover by impermeable surfaces that increase runoff, and construction of drainage systems that increase runoff speed.

Location

The surface waters of Kansas that flow through the 12 river basins of the state are named and delineated in Figure 3.32 along with the 24 federal reservoirs that play a large role in flood control in Kansas. There are more than 134,000 miles of interior streams and surface waterways. According to the FEMA Community Status Book, 89 communities are mapped but not in the NFIP program. There are 388 communities in the Regular Phase of the Program. Of those in the Regular Phase, there are 63 that have no special flood hazard areas. There are 16 communities in the emergency phase of the program. Of those Emergency Phase communities, Elk County, Greenwood County, City of Wilsey, Woodson County, and Lincoln County do not have flood maps. This information can be found in the FEMA Community status book, which can be found at http://www.fema.gov/cis/KS.pdf. The major basin map in Figure 3.32 and watershed map in Figure 3.33 are presented in lieu of these flood maps, as it is not practical to include the detailed flood hazard maps for all the mapped communities. Watersheds in 10 of the 12 basins are designated by the Kansas Water Plan as “priority” for rural flood loss reduction.

They were identified by the U.S. Department of Agriculture Soil Conservation Service (now Natural Resources Conservation Service) in 1986 based on historical flood damage, the percentage of the watershed occupied by floodplains, and the potential for construction of additional watershed floodwater retention structures. These priority flood hazard areas are illustrated in Figure 3.32 and listed here: Lower Arkansas, Upper Arkansas, Kansas-Lower Republic, Marais des Cygnes, Missouri, Neosho, Smokey Hill-Saline, Solomon, Verdigris, and Walnut. Figure 3.33 illustrates that the majority of the problem watersheds are located in the eastern half of the state. Exceptions are certain watersheds in the Upper Arkansas basin in the western half of the state.

Figure 3.32. Kansas Rivers, Reservoirs, and Major River Basins

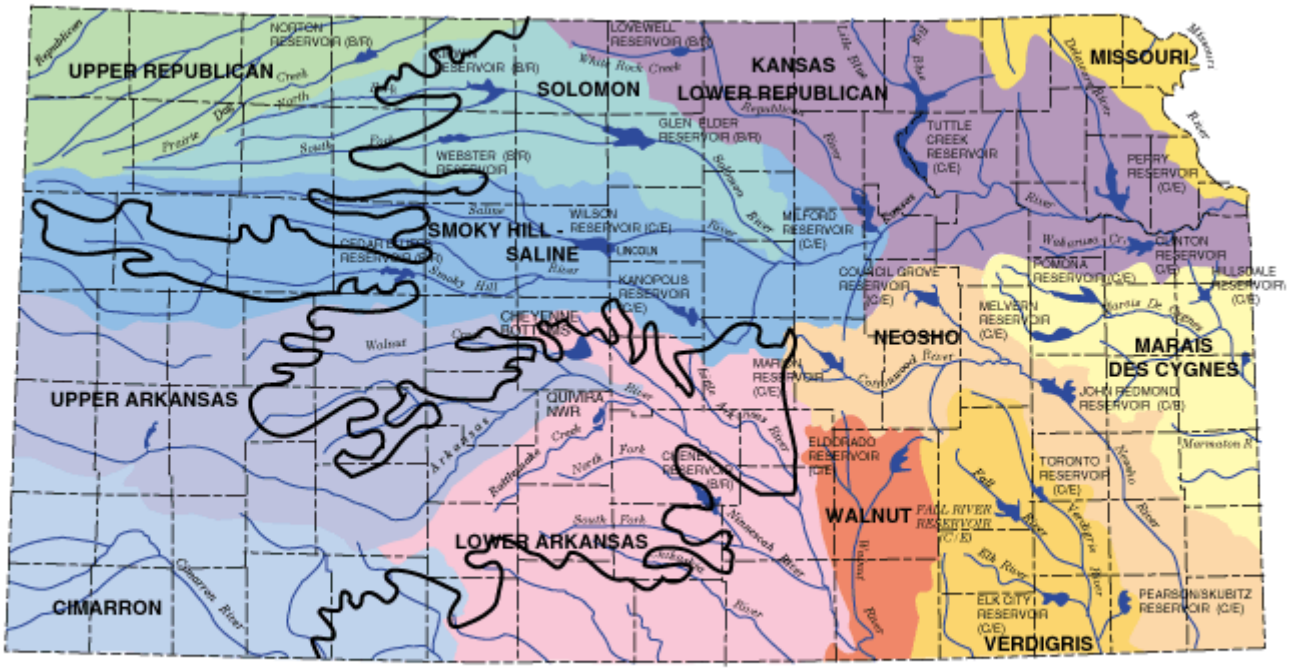
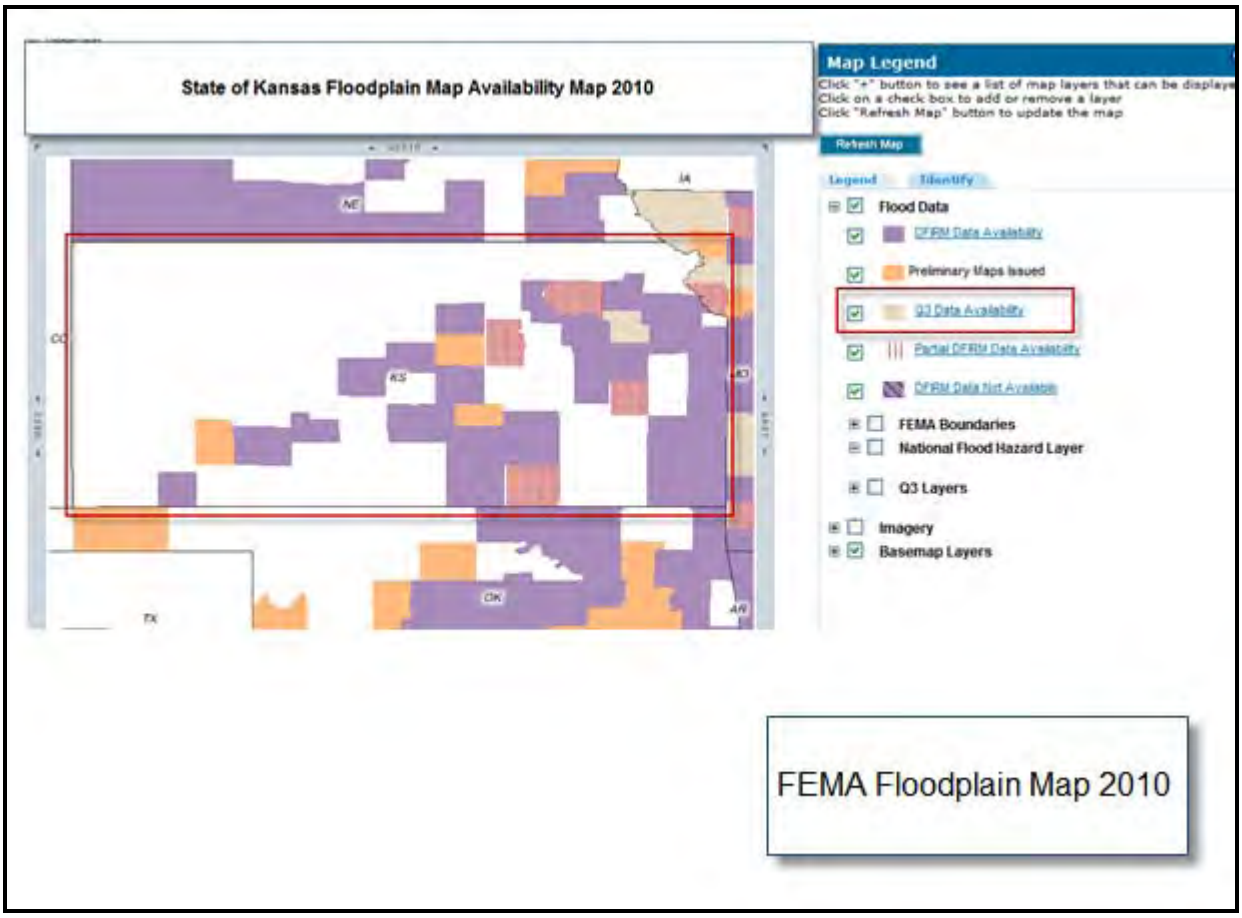


Figure 2. Kansas Rivers and Reservoirs (B/R = Bureau of Reclamation; C/E = Corps of Engineers) and major river basins. The two largest Kansas wetlands (Cheyenne Bottoms and Quivira National Wildlife Refuge, NWR) are also shown. The area west of the solid black line shows the extent of The High Plains aquifer in Kansas.

Source: Surface Water in Kansas and its Interactions with Groundwater, 2000, www.kgs.ku.edu/HighPlains/atlas/atswqn.htm

The following map portrays current available flood zone mapping for the State of Kansas. Through the FEMA RiskMap initiative, these maps will be updated in the future, and integrated into the next major Kansas mitigation planning initiative.

Figure 3.33 State of Kansas FEMA Flood Map Availability Map



The latest FEMA Q3 (digital flood zone data) is used to create flood zone analysis for the State of Kansas. Please reference the map below to illustrate the boundaries of the flood hazard in Kansas. As Q3 is updated in the future, it will be integrated into the next mitigation plan update for the state.

Figure 3.33.A State of Kansas Q3 Data Availability Map

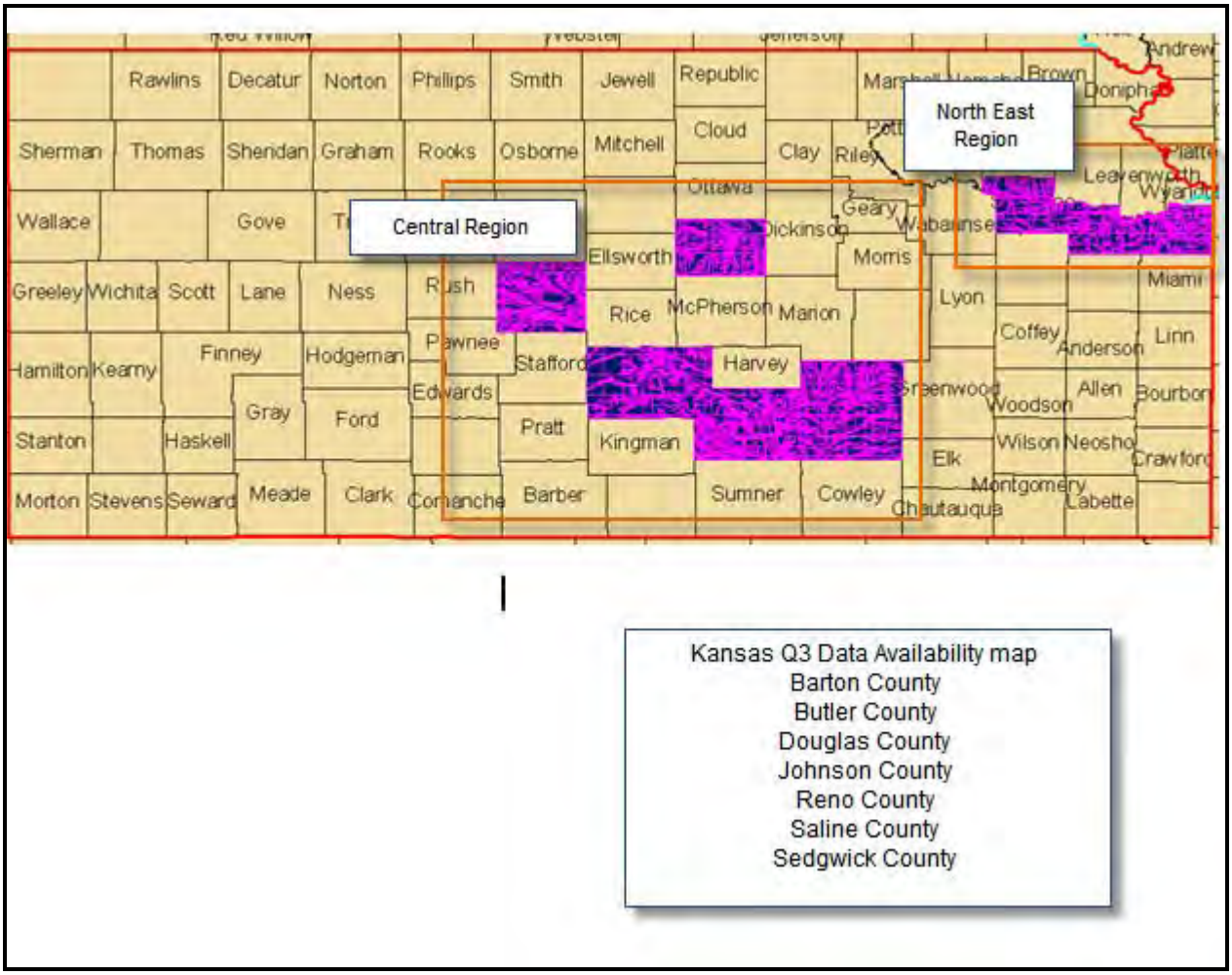


Figure 3.33.B State of Kansas Flood Boundaries Map 1

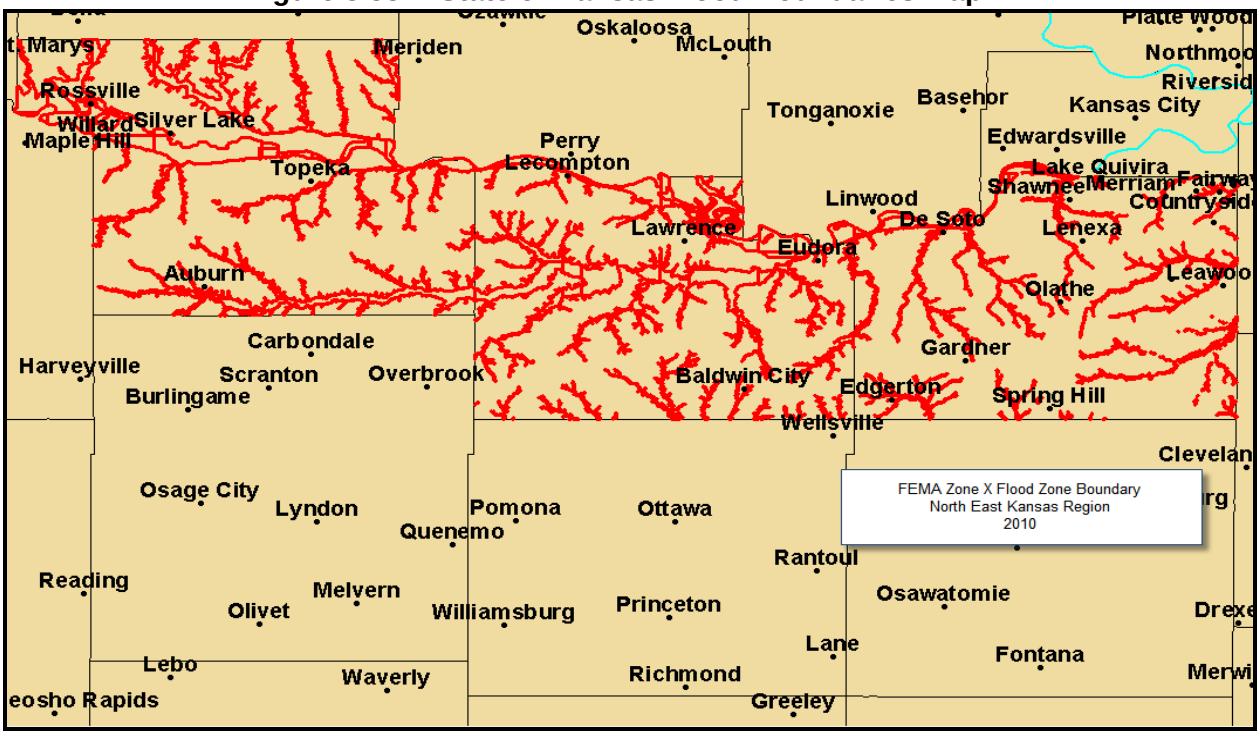
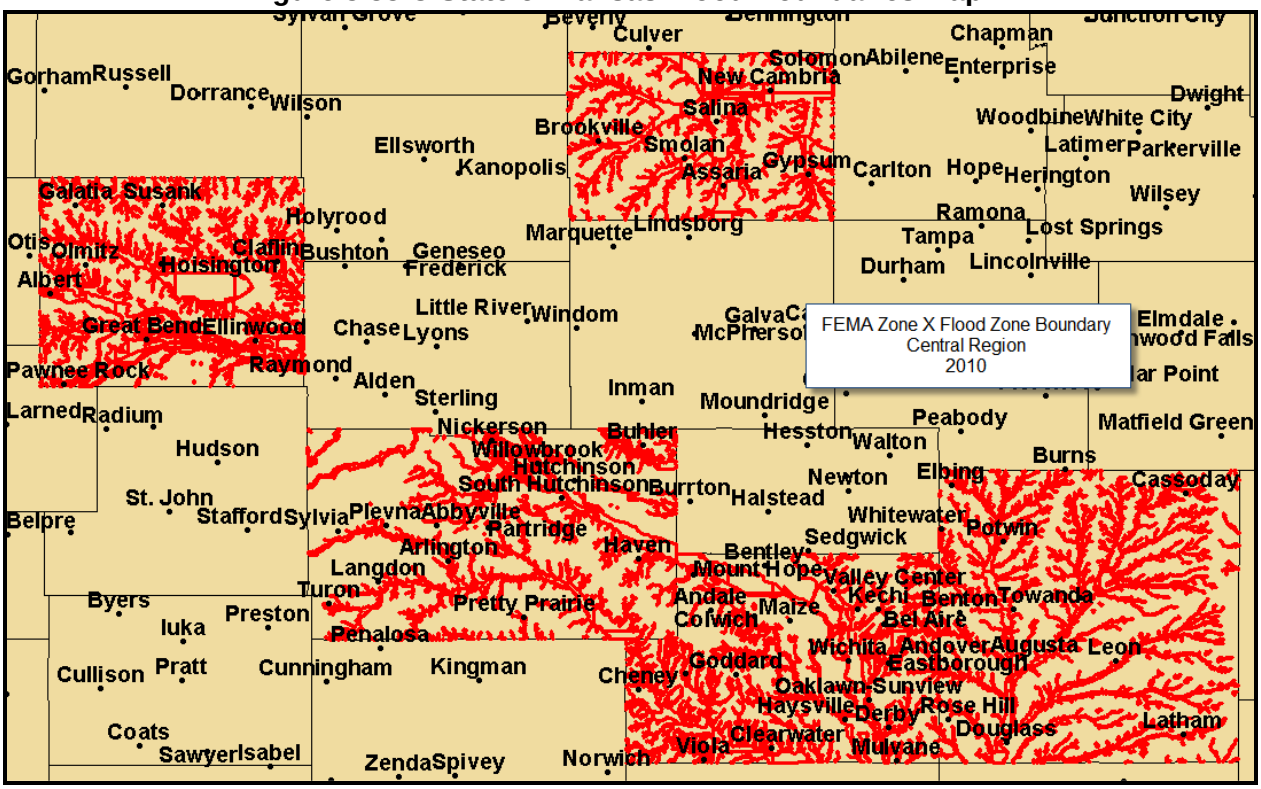


Figure 3.33.C State of Kansas Flood Boundaries Map 2



Few natural lakes occur in Kansas. There are an estimated 315 publicly-owned lakes, reservoirs, and ponds in the state, which cover over 188,000 acres. The largest lakes in Kansas are the manmade impoundments formed behind dams built by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. These reservoirs store water for flood control, irrigation, municipal and industrial water supply, and other uses. Twenty-four major reservoirs have been built in the state, 17 by the U.S. Army Corps of Engineers and 7 by the U.S. Bureau of Reclamation.

The average annual precipitation varies significantly across the state. Precipitation in the eastern part of the state exceeds an average of 40 inches, while the average in the western part of the state is less than 20 inches.

Figure 3.34 shows the distribution of water runoff in Kansas. Although the climatically controlled rainfall variation is significant, average annual runoff across the state varies much more than the precipitation. The average runoff ranges from approximately 10 inches in the east (25% of precipitation) to 0.1 inch in the west (less than 0.6 of 1% of precipitation), a 100-fold change in the runoff across the state. At the time of the 2010 revision, the Kansas Geological Survey had not updated the average annual runoff map in Figure 3.34. The Kansas Division of Emergency Management contacted the Kansas Geological Society (KGS) on 10-5-2010. It was determined that the Average Annual Runoff Map is most current as of the year 2000. No plans to update the map have been made to date.

Figure 3.34. Average Annual Runoff

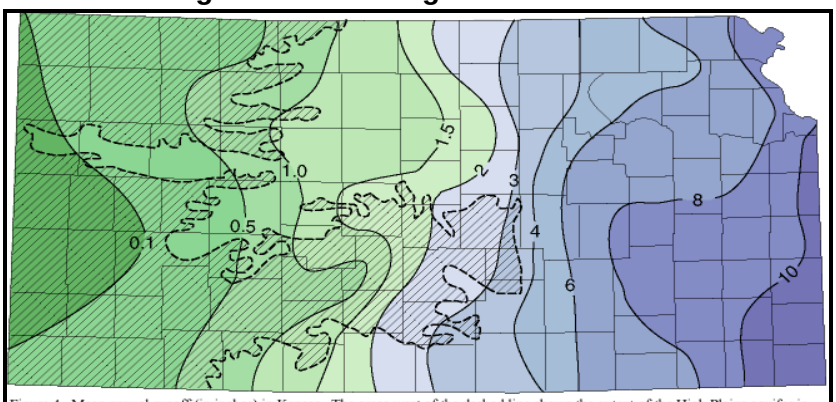
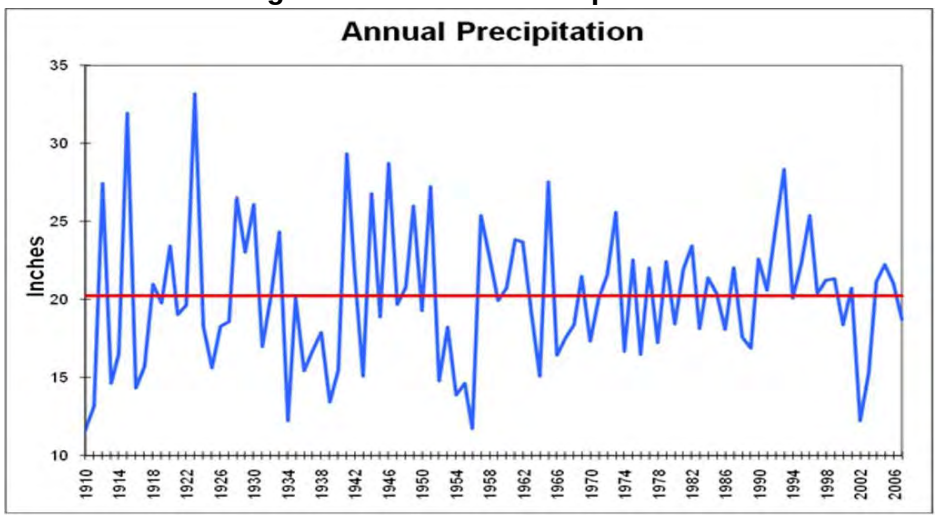


Figure 4. Mean annual runoff (in inches) in Kansas. The areas west of the dashed line shows the extent of the High Plains aquifer in Kansas (Adapted from Wetter, 1987).

Source: Surface Water in Kansas and its Interactions with Groundwater, 2000, www.kgs.ku.edu/HighPlains/atlas/atswqn.htmPrecipitation data was derived from 45 stations in 12 northwest Kansas counties. Precipitation averages 20.17 inches annually since 1910.

Figure 3.35. Annual Precipitation



Source: Kansas State University, Research and Extension, Weather Data Library, www.oznet.ksu.edu/wdl/Maps/Climatic/AnnualPrecipMaps.asp

Previous Occurrences

According to the National Climatic Data Center Storm Events database, there were 2,050 flood events in Kansas between 1996 and 2009. Total property and crop damage for these events is estimated at $465 million. There were 21 deaths and 24 injuries in this time period. This suggests that Kansas experiences an average of 157 floods, $35 million in flood losses, 2 flood-related death, and 2 flood-related injuries each year.

Major floods impacted Kansas in 1844, 1903, 1935, 1951, 1965, 1973, 1976, 1981, 1986, 1993, 1998, 2001, 2007, and most recently in 2009. Details about some of these events can be found on the following pages. Section 3.2 Hazard Identification contains more detailed information about the counties that were included in presidential declarations. Additional presidential declarations for flooding are listed in the tornado section later in this chapter. These disasters were for both flooding and tornadoes.

FEMA-1860-DR: Severe Storms and Flooding – September 30th, 2009

On September 2, 2009, Governor Mark Parkinson requested a major disaster declaration because of severe storms, accompanied by large hail, lightning, high winds, and torrential rains during the period of July 8-14, 2009. The governor requested a declaration for Public Assistance for eight counties and hazard mitigation for all counties. During the period of August 3 to September 2, 2009, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments, and that federal assistance is necessary.

Affected counties included: Sedgwick, Franklin, Anderson, Linn, and Bourbon (See DR-1860 Map in Appendix X).

FEMA-1711-DR: Severe Storms and Flooding—July 2, 2007 (June 26–30)

Beginning June 26 and continuing through June 30, 2007, strong storms across south central and southeast Kansas produced torrential rainfall and subsequent flooding/flash flooding. Some counties, which were still recovering from flooding in mid-May, received over a foot of rain.

Up to 21 inches of rain was reported near Fredonia (Wilson County). As of the morning of June 30, 16½ inches had fallen in 48 hours in Moline (Elk County), 12½ of which fell in 24 hours. Nine inches fell in four hours in Winfield (Cowley County) on the afternoon of June 29. Wilson County was one of the hardest hit counties. Initially, Neodesha was only accessible by boat and air. Both the water and sewer plants were compromised by the flooding, which resulted in a boiling water order for the area. Approximately 3,000 people were without power in Fredonia for several days. In Miami County, the Kansas National Guard was sent to help with a mandatory evacuation of Osawatomie, one of the hardest hit communities in eastern Kansas. The town evacuated 40% of its 4,600 residents after Pottawatomie Creek and the Marais des Cygnes rose out of their banks.

Aerial photo of the oil contaminated flood water in Coffeyville in 2007

In Montgomery County, the heavy rains caused the Verdigris River to overflow its banks, top protective levees, and flood the town of Coffeyville. The river crested more than 10 feet above flood stage, setting a new record for the river. Approximately 2,000 citizens and more than 200 homes were affected. In addition, the Coffeyville Resources refinery and nitrogen fertilizer plant, and many local businesses were flooded. As floodwaters rose, officials at Coffeyville Resources ordered the facilities to shut down and be evacuated. Despite their efforts to secure the refinery, an estimated 71,000 gallons of crude oil and a small amount of oil from the refinery's sewer system were swept away by flood waters. During the plant shutdown, the pump system from the east tank storage facility was shut down, but oil continued to flow because of an elevation difference, causing the main oil storage tank in the refinery to overflow. The U.S. Environmental Protection Agency conducted monitoring for the presence of volatile organic compounds in flood waters in Coffeyville and downstream, but indicated the presence of these compounds was not at a "level of concern." Contamination and health issues led local officials to prevent many people from returning to their flood damaged homes before it was determined safe.

FEMA-1615-DR: Severe Storms and Flooding—November 21, 2005 (October 1–2)

A series of storms moving over the same locations in northeast Kansas again and again, until finally some spots in the area had received as much as a foot of rainfall. The rainfall caused many road closures because of flooding and brought flooding to urban and rural areas as several local creeks roared out of their banks. Rossville in Shawnee County was likely the hardest hit: 80% of the geographical area was flooded. Many locations in Topeka reported flooding and road closures. Jackson and Jefferson Counties also had many road closures and road damage.

FEMA-1258-DR: Severe Storms and Flooding— October/November 1998 (October 30–November 15)

From October 30 to November 15, storms generated by Hurricane Mitch impacted south central Kansas with heavy rains and flooding. The Arkansas, Cottonwood, Whitewater, and Walnut Rivers recorded all-time record levels. Major flooding occurred through west Wichita along the Cowskin Creek. Augusta, in western Butler County, was especially hard hit. Flooding was widespread, inundating many roads. There were 5,300 people evacuated. There were two injuries, one fatality, and $37.8 million dollars in damage.

FEMA-1254-DR: Severe Storms, Flooding, and Tornadoes—October 1998 (October 1–8)

From October 1-8, extensive thunderstorms with strong wind gusts, heavy rains, hail, tornadoes, and flooding impacted one county in southwestern Kansas and several counties along the eastern edge of the state. Many low lying roads were blocked by flash flooding. The storms damaged over 500 residential structures and impacted numerous businesses. There were two fatalities.

FEMA-1000-DR: Flooding, Severe Storms—Great Flood of 1993—July 22, 1993

About 40 inches of rain fell during the first seven months of the year in northeast Kansas. Runoff resulted in further flooding throughout the lower Missouri River basin in central and east Kansas. One of the most devastating floods in U.S. history (a once in 100-500-year event), this event put millions of acres of farmland under water for weeks, damaged roads, and made rivers un-navigable. Waters overtopped or destroyed numerous levees and eroded valuable topsoil. Fifty-six Kansas counties, (nearly half the counties in the state) were included in the federal disaster declaration. The flood caused a total of 47 deaths in nine states, including two in Kansas. A high percentage of crop acres in the Kansas City District floodplains suffered losses because of the overtopping of 9 of 15 units in the federally-constructed Missouri River Levee System and virtually all the nonfederal farm levees in the district. More than 1.4 million crop acres were classified as failed, which resulted in $359 million in damage. Damage to property was estimated at $15 to $20 billion across all nine states (Corps 1994).

Damage to cities and small towns in the Kansas City District was estimated at $661 million. Damage to the public sector (infrastructure) was estimated at $274 million. The total cost of repairing federal levees was estimated at $41.9 million and nonfederal levees at $300 million (Corps 1994). Damage prevented by Kansas District reservoirs was estimated at $4 billion, while damage prevented by local protection levees, including those at Kansas City and Topeka, was estimated at $4.7 billion. Levees in the Missouri River Levee System, which primarily protect agricultural land, prevented an estimated $188.3 million in damage (Corps 1994).

FEMA-644-DR: Severe Storms, Flooding, Tornadoes—July 18, 1981 (June 14)

On the afternoon of June 14, a series of intense thunderstorms produced 5 to 20 inches of precipitation in about 12 hours near Great Bend. The storm affected about 300 square miles of tributaries to the Arkansas River upstream from Great Bend and caused approximately $42 million in damage. The recurrence interval was likely greater than 100 years.

FEMA-539-DR: Severe Storms, Flooding—September 20, 1977 (September 12–13)

This event in the Kansas City area resulted in 25 fatalities and approximately $50 million in property damage. As much as 11 inches of precipitation fell in 24 hours, which resulted in peak discharges with recurrence intervals greater than 100 years on most streams in the metropolitan area.

FEMA-201-DR: Flooding—June 23, 1965 (June 17–25)

This flood affected the Arkansas, Little Arkansas, Solomon, Marais des Cygnes, and Big Blue river basins, causing approximately $16 million in damages, most of which was to cropland.

July 10–13, 1951

In July 1951, excessive rain caused serious flooding in the Kansas, Missouri, Verdigris, Arkansas, and Neosho river basins, extending over half of the state. Flooding on the Kansas River and the downstream Missouri River occurred following an average rainfall of 6.4 inches in May, 9.6 inches in June, and a stretch of four days in mid-July with as much as 18.5 inches over the Osage-Marais Des Cygnes and the Kansas River. The Kansas River was above flood stage for 10 straight days. There were 24,000 people evacuated. Fifteen lives were lost as a result of this flood. Damage was estimated at $800 million, 42% of which was attributed to the loss of business income outside the flooded area, emergency aid, and relief. Urban damage accounted for 39% and rural losses the remaining 19%.

May 28–June 6, 1935

An intense storm caused these floods in northwestern Kansas. There were 10 deaths on the Republican and Upper Kansas Rivers.

May–June 1903

Flooding occurred in the Republican and Kansas River basins. In Topeka, it forced 4,000 people from their homes and killed 38. All of north Topeka was under water, up to 10 feet in some places. The Kansas River expanded to 2-3 miles wide and destroyed three bridges.

Other Notable Flood Events

- April 26, 2009 - Heavy rainfall from numerous thunderstorms during the afternoon, evening, and overnight hours on the 26th produced widespread flooding across much of Harper County. Rainfall amounts across the county ranged from 3 to 6 inches. Numerous roads were closed countywide. It is estimated that around 100 homes were flooded or received some form of water damage in the Anthony area, along with several other homes and businesses across the county. Portions of the elementary school and hospital in Harper were flooded. Three water rescues took place, one of which produced an injury near Third Lake Road when a vehicle attempted to cross a flooded roadway. Crop damage estimates are unknown, and property damage values are rough estimates. The Wichita Eagle, Harper Advocate, Anthony Republican and the Hutchinson News contributed to this report.
- September 12, 2008 - Nine to twelve inches of rainfall during the morning commute hours caused widespread street flooding of roadways up to 2 to 3 feet deep on the west side of the city of Wichita. Law enforcement officials reported 150 people were rescued from vehicles or evacuated because of the high water. There were 114 homes reported to have some type of surface flooding because of the heavy rainfall and sewers and sump pumps backed up into 141 more homes. This unprecedented amount of rainfall mainly fell during a five-hour period, reminding some of the Halloween Flood of 1998. The large amount of rainfall caused the Cowskin/Calfskin Creek to once again come out of its banks, flooding homes in the Dells and Hidden Lakes Subdivision. Thirty-five people were evacuated from the Park West Retirement home along the banks of the creek. Calls about stalled vehicles overwhelmed towing businesses across the city.
- May 22, 2008 - Street flooding with water up to one foot deep was reported in the city of Norton via the National Spotter Network. Radar also indicated extremely heavy rainfall occurring across much of central Norton County at this time. Local newspapers later stated that Norton County roads incurred an estimated $500,000 in damage as a result of the heavy rainfall and flooding in the area.
- May 27, 2007 - Numerous, slow-moving thunderstorms produced widespread 4 to 7 inch rainfall amounts across primarily the northwestern two-thirds of Saline County from the

evening hours on May 23rd, to the early morning hours on May 24th. Excessive runoff from this heavy rain caused widespread countywide flooding for days. Numerous rural and city roads were closed because of high water. The Mulberry Creek reached record flood stage during the late afternoon hours of the 24th, resulting in road closures and evacuations across portions of Salina. Mandatory evacuations were needed in the communities of Hedville and Bavaria, because of the rapidly rising Mulberry and Spring Creeks. The rising Smoky Hill River effectively closed all roads leading in and out of New Cambria. Some water rescues were needed across the county, but there were no reported injuries. Numerous homes and businesses received extensive flood damage, as well as various roads and one bridge across the county. Additionally, the Salina Municipal Airport terminal building received fairly extensive flood damage. Roughly $3.5 million in public damages was suffered across the county, with likely around $3 million in private damages.

- May 5, 2007 - Flash flooding was reported throughout Barton County. Highway 96, nine miles west of Great Bend was closed as water started flowing over the road. An observer in the area reported 3.22 inches of rain in just 3 hours. Highway 56 in Pawnee Rock was closed because of flood water. In Hoisington the intersection of 3rd Street and Main was closed because of high water. An observer reported approximately 3 inches of rain in 3 hours in that part of Barton County. Seventy to eighty homes were flooded on the north side of Ellinwood. According to Barton County Emergency Management, the county documented roughly 30 million dollars in damage. This includes damages to private property including crop damage, damage to farm equipment, farmsteads and public roads. The Great Bend Tribune contributed to this narrative.
- May 2006—Three inches of rain fell in west central Anderson County on May 21. Streams rose out of their banks and water flowed over rural roads. Debris blocked storm drains in Topeka on May 29. Portions of I-70 in west Topeka were closed because of water on the roadway. Flash flooding occurred in central Washington County on May 29 when 4.65 inches of rain fell in less than two hours. On May 30 and 31, flash flooding occurred in Lyon, Osage, Anderson, Coffey, Ottawa, and Republic Counties. Hardest hit was the city of Emporia, where widespread street flooding affected the city. There were water rescues of stranded motorists, and many homes and businesses were flooded.
- June 8-9, 2005—Ten to fifteen inches of rain caused widespread flash flooding in Harvey, Butler, and northern Sedgwick Counties. Receiving 12-15 inches of rain in a 10-hour period, Harvey County was inundated with flash flooding that left most roads and highways barricaded. Damage was estimated at $1.5 million. The flash flooding in Harvey County spread south across the county border into northern Sedgwick County, where 19 homes, 12 of them mobile variants, were flooded. Damage was estimated at $150,000.
- June 3-15, 2005—Cheyenne, Edwards, Harper, Haskell, Linn, Rush, and Stanton Counties were designated as primary disaster areas by the U.S. Department of Agriculture because of losses caused by excessive rain, flash flooding, and flooding. Twenty-nine contiguous counties were also eligible for assistance.
- August 30, 2003— A flash flood on Jacob Creek inundated a quarter mile section of the interstate 12 miles southwest of Emporia. Seven vehicles were swept off the turnpike. Six people were killed.
- April 2002—As a result of severe storms, tornadoes, and flooding, the Small Business Administration declared a disaster for businesses in Bourbon, Cherokee, Crawford, and Linn counties.
- June 2001—Storms dumped 5½ inches of rain on Easton in Leavenworth County. Stranger Creek overflowed and tore through houses, mobile homes, and fields and closed the

Kansas Turnpike. Officials estimated 75 to 100 households in the town of about 360 residents were flooded. Twenty-six homes were destroyed, 21 received major damage, and 25 others had minor damage.

- February 2001—Heavy rains in eastern Kansas closed roads in Neosho and Allen Counties and nearly isolated Easton in Leavenworth County. One person was killed in Mayetta.
- 1999—Flooding in northeast Kansas caused about $2 million in damage.
- September 12, 1997— A major flash flood swept through parts of Dodge City. Around 200 homes and businesses in Dodge City were damaged from flooding waters. One thousand citizens had to be evacuated, but no injuries or deaths were reported. The flooding was the result of extremely heavy rain that fell in just a short period of time. There were numerous reports of 5 to 6 inches of rainfall. One location reported 9.5 inches just south of the city limits.
- October 1986— A significant amount of flooding occurred in the southeast part of the state (Marmaton, Little Osage, Marais des Cygnes, and Arkansas river basins).
- July 2-4, 1976—Flooding was severe in the downstream reaches of the Verdigris River Basin as a result of an intense storm over southeastern Kansas. The storm produced 24-hour precipitation that totaled about 6-13 inches and two-day precipitation of as much as 16 inches. The most severe flooding was confined to the main stem and tributaries of the Elk River and tributaries of the Fall and lower Verdigris Rivers. There was one death on the Verdigris River.
- September–October 1973— A series of severe floods occurred on streams throughout the central and east-central parts of the state between late September and early October. As much as 11 inches of rain fell over four days. Several locations reported precipitation in excess of 7 inches on September 26. The flooding was most severe in Rattlesnake and Cow Creeks in the south-central part of the state and in the Smoky Hill River, its tributaries, and tributaries of the Republican River in north-central Kansas.
- 1968—There were three deaths on the Arkansas River.
- June 1844— A large storm caused flooding that affected most of the north-central and northeast parts of the state (Kansas and Marais des Cygnes River basins). The recurrence interval was likely much greater than 100 years.

Probability

Floods have a 1% chance of occurrence in any given year in identified special flood hazard areas. At least one Kansas stream experiences severe flooding, on average, every year, thus, this hazard's CPRI probability is "**Highly Likely**" within the calendar year. Annualized losses, based on data on flood events from 1993 through 2010 from the National Climatic Data Center, are estimated at $46 million.

Hazard	Flood	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 – Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 -	Event is probable within the next five years		x

Possible	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 – Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x

Local Plan Integration

For the 2010 update, the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.33.

Table 3.33. Local Plan Statistics for Flood

County	Region	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities	Approval Date	Expiration Date
Allen	Southeast	High	16	$5,718,000	N/A	N/A	N/A	1/7/2009	1/7/2014
Brown	Northeast	Moderate	13	$26,379,555	N/A	0	0	3/12/2010	3/12/2015
Butler	South Central	High	78	$33,269,000	N/A	3	2	8/3/2009	8/3/2014
Chase	Northeast	Moderate	14	N/A	N/A	N/A	N/A	7/28/2009	7/28/2014
Cherokee	Southeast	High	74	$1,015,000	N/A	N/A	N/A	5/1/2009	5/1/2014
Cloud	North Central	Moderate	13	$440,000	N/A	N/A	N/A	2/26/2010	2/26/2015
Cowley	South Central	High	48	$33,656,000	$612,000	2	1	2/26/2010	2/26/2015
Crawford	Southeast	High	50	$1,346,000	$655,000	N/A	N/A	8/4/2009	8/4/2014
Dickinson	North Central	High	22	$3,800,000	$809,043	N/A	N/A	9/29/2009	9/29/2014
Douglas	Northeast	High	34	$6,800,000	$235,000	8	N/A	6/1/2009	6/1/2014
Elk	Southeast	Moderate	20	N/A	$514,108	N/A	N/A	6/15/2009	6/15/2014
Ellsworth	North Central	Moderate	14	$9,900,000	$505,000	N/A	N/A	9/9/2009	9/9/2014
Harper	South Central	High	N/A	$33,250,000	$655,000	2	1	11/12/2009	11/12/2014
Harvey	South Central	High	9	N/A	$922,996	N/A	N/A	1/19/2010	1/19/2015
Jewell	North Central	Moderate	3	$1,500,000	$3,050,000	N/A	N/A	6/1/2010	6/1/2015
Johnson	KC Metro	High	81	N/A	$147,335	N/A	N/A	5/26/2009	5/26/2014
Kingman	South Central	Moderate	14	$66,000	$289,000	N/A	N/A	4/6/2010	4/6/2015
Kiowa	South Central	Moderate	8	$732,620	$157,314	N/A	N/A	11/17/2009	11/17/2014
Labette	Southeast	High	27	N/A	$4,243,361	N/A	N/A	6/11/2009	6/11/2014
Linn	Northeast	High	47	$7,350,000	$1,500,000	N/A	N/A	11/30/2009	11/30/2014
Lyon	Northeast	High	31	$42,255,000	N/A	N/A	N/A	12/14/2007	12/14/2012
Marion	South Central	Moderate	N/A	N/A	N/A	N/A	N/A	9/6/2007	9/6/2012

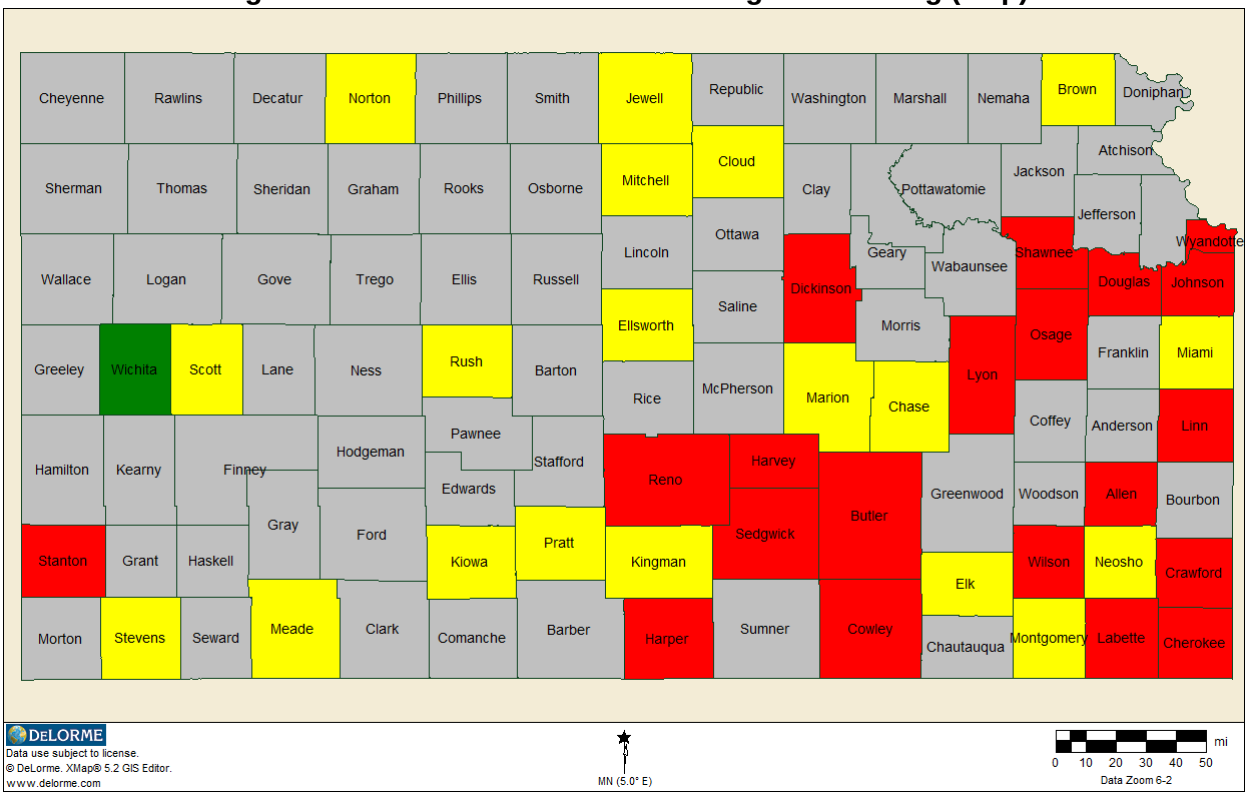
Meade	Southwest	Moderate	14	N/A	N/A	N/A	N/A	8/31/2009	8/31/2014
Miami	Northeast	Moderate	35	$16,350,000	$1,500,000	N/A	N/A	6/29/2010	6/29/2015
Mitchell	North Central	Moderate	N/A	N/A	N/A	N/A	N/A	1/5/2010	1/5/2015
Montgomery	Southeast	Moderate	31	N/A	$4,464,861	N/A	N/A	1/23/2009	1/23/2014
Neosho	Southeast	Moderate	17	N/A	$4,539,373	N/A	N/A	6/4/2009	6/4/2014
Norton	Northwest	Moderate	6	$525,000	$12,000.00	N/A	N/A	9/9/2009	9/9/2014
Osage	Northeast	High	40	$7,113,000	$933,000.00	N/A	N/A	6/11/2009	6/11/2014
Pratt	South Central	Moderate	12	N/A	N/A	N/A	N/A	3/23/2010	3/23/2015
Reno	South Central	High	28	$7,150,000	$5,278,059	N/A	N/A	11/18/2009	11/18/2014
Rush	Northwest	Moderate	19	N/A	$212,472	N/A	N/A	1/5/2010	1/5/2015
Scott	Southwest	Moderate	5	N/A	N/A	N/A	N/A	1/5/2010	1/5/2015
Sedgwick	South Central	High	54	$36,000,000	N/A	3	2	7/20/2009	7/20/2014
Shawnee	Northeast	High	42	$5,000,000	$0.00	0	0	5/6/2010	5/6/2015
Stanton	Southwest	High	10	N/A	N/A	N/A	N/A	5/3/2010	5/3/2015
Stevens	Southwest	Moderate	8	N/A	N/A	N/A	N/A	2/11/2010	2/11/2015
Wichita	Southwest	Low	8	$0.00	$0.00	0	0	4/15/2009	4/15/2014
Wilson	Southeast	High	15	N/A	$5,038,665	N/A	N/A	3/2/2009	3/2/2014
Wyandotte	KC Metro	High	46	N/A	N/A	N/A	N/A	2/17/2010	2/17/2015
Totals			**975**	**$48,150,000**	**$31,808,726**	**18**	**6**		

After reviewing the data from the local plans throughout the State of Kansas the committee calculated averages for floods, as shown in the table located below, the state can expect an average of $82,008 in damages from a single flood event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.34. Local Plan Averages for Flooding

	Deaths	Injuries	Total Damages
Totals	6	18	$79.958.726
Average per County	0.15	0.45	$1,998,968
Average Per Event	0.006	0.02	$82,008

Figure 3.35A. Local Plan Hazard Rating for Flooding (Map)



Source: Bold Planning Solutions

Red – High Risk Rating – 20 Jurisdictions
Yellow – Moderate Risk Rating – 19 Jurisdictions
Green – Low Risk Rating – 1 Jurisdiction
Gray – No Plan or No Rating – 65 Jurisdictions

Risk Rating Details: High, Moderate, and Low risk rankings are derived from FEMA-approved Risk Assessment criteria for local mitigation plans across the State of Kansas. Based on their CPRI, the hazards were separated into three categories of planning significance: High (3.0-4.0), Moderate (2.0-2.95), and Low (1.1-1.95) at the local jurisdiction level. Please review entire CPRI ranking methodology on page 3.25.

Vulnerability and Potential Losses by Jurisdiction

The vulnerability of Kansas to flooding is significant. While health and safety impacts of flooding can be devastating, loss of life to floods during the last 50 years has declined while economic losses (e.g., property, crop, and infrastructure) have continued to rise (USGS 2006). This increase in losses can be attributed in part to encroachment of urban and agricultural development onto floodplains, which increases the potential for flood damage. Kansas' environmental and cultural resources are also susceptible to flooding. Prolonged flood conditions, such as experienced in 1993, can kill wildlife, contaminate recreational areas, remove vegetation, and saturate the ground for months.

Flood Insurance Claims Analysis

The state analyzed National Flood Insurance Program (NFIP) flood-loss data to determine areas of Kansas with the greatest flood risk. As of June 2010, 404 communities were National Flood Insurance Program (NFIP) participants, including 61 that do not have special flood hazard

areas and 108 that are only minimally flood-prone. Ninety-eight Kansas communities that have flood hazard areas are not NFIP participants. This includes six suspended communities and three that have withdrawn. Kansas flood-loss information was culled from FEMA's "Policy and Loss Data by Community with County and State Data," which documents losses from 1978 through May 26, 2010.

There are several limitations to this data, including:

- Only losses to participating NFIP communities are represented,
- Communities joined the NFIP at various times since 1978,
- The number of flood insurance policies in effect may not include all structures at risk to flooding, and
- Some of the historical loss areas have been mitigated with property buyouts.

Despite these limitations, the data depicts a pattern of historical flood losses in the state. The greatest losses have been in Wyandotte, Sedgwick, and Butler Counties. Table 3.35 shows the details of the 10 Kansas counties with the greatest historical dollar losses. With the exception of Barton County, they are all in the eastern half of the state. None of these counties is part of the NFIP Community Rating System (CRS), but the cities of Olathe and Shawnee in Johnson County are currently part of the CRS with class ratings 8. Detailed information about flood insurance losses and policies for all Kansas counties is in Appendix F Flood Insurance Claims and Coverage up to 2010.

Table 3.35. Top 10 Counties for Flood Insurance Dollars Paid (Historical), 1978–2010

County	Dollars Paid ($ Historical)	Flood Claims	Current Policies	Coverage ($)
Sedgwick	10,963,389	877	2,382	386,220,900
Wyandotte*	9,937,539	398	308	77,449,600
Butler	9,379,825	436	462	73,975,400
Johnson	8,002,388	944	944	231,828,900
Montgomery	5,054,230	262	319	43,856,200
Saline	4,469,450	223	437	60,414,700
Shawnee	2,995,298	253	956	151,397,200
Harvey	2,797,116	354	474	51,711,000
Allen	2,713,350	84	176	$14,090,700
Barton	2,439,165	519	236	$19,714,400

Source: FEMA, "Policy and Loss Data by Community with County and State Data," May 26, 2010
*Wyandotte County has been suspended from the NFIP since 1989, but Kansas City, Bonner Springs, and Edwardsville are participants.

Repetitive Loss Analysis

A high priority in Kansas and nationwide is the reduction of losses to repetitive loss structures. These structures strain the National Flood Insurance Fund. They increase the NFIP's annual losses and the need for borrowing and, more importantly, they drain resources needed to prepare for catastrophic events. The NFIP defines a repetitive loss property as "any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978. At least two of the claims must be more than 10 days apart."

Table 3.36 illustrates the number and location (county) of Kansas' repetitive loss properties. The table ranks counties by claim amounts paid. Johnson County has the most repetitive loss properties with 73, Wyandotte, ranks second with 45 repetitive loss properties. Wyandotte, however, has had the highest amount of repetitive flood claims paid (over $6.5 million).

Table 3.36. Kansas Repetitive Loss Properties (ranked by number of properties)

County	# of Properties	# Mitigated	# Insured	Claims Paid ($)	# of Losses
Johnson	73	0	20	3,267,246	207
Wyandotte	45	0	12	6,507,439	171
Sedgwick	41	0	16	2,395,165	95
Montgomery	25	0	9	1,029,500	70
Saline	17	0	8	2,114,543	43
Butler	14	0	6	581,808	41
Sumner	13	0	7	624,433	39
Cowley	12	0	3	299,019	17
Lyon	8	0	1	514,872	18
Crawford	8	0	3	486,033	23
Leavenworth	8	0	6	436,044	17
Bourbon	7	0	1	646,895	19
Ellis	6	0	1	68,009	14
Harvey	5	0	1	212,772	12
Douglas	4	0	1	128,144	13
Barton	4	0	0	95,767	8
Labette	4	0	1	78,752	10
Cherokee	3	0	1	150,573	11
Shawnee	3	0	2	104,107	8
Jefferson	2	0	2	112,239	4
Riley	2	0	1	35,442	4
McPherson	2	0	1	29,240	4
Ford	2	0	1	24,190	4
Doniphan	1	0	0	123,000	2
Wilson	1	1	0	38,599	4
Reno	1	0	0	21,914	3
Seward	1	0	0	6,077	2
Allen	1	0	0	4,116	2
Total	**313**	**1**	**104**	**20,135,938**	**865**

Severe Repetitive Loss Analysis

The Flood Insurance Reform Act of 2004 identified another category of repetitive loss, severe repetitive loss, and defined it as "a single family property (consisting of one-to-four residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with cumulative amounts of such claims payments exceeding $20,000; or for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

As of June 1st, 2009, there were six validated properties on Kansas' severe repetitive flood loss list. An additional four properties were pending validation. With 29 losses, total payments, building and contents, to these eight properties equaled $987,006 million.

Table 3.37. Kansas Severe Repetitive Loss Properties

Community Name	Total Building Payment	Total Contents Payment	Total Payment	Losses
MISSION HILLS, CITY OF	220,623.09	76,503.50	297,126.59	3
EASTON, CITY OF	79,056.37	27,586.72	106,643.09	2
COFFEYVILLE, CITY OF	52,852.51	5,732.87	58,585.38	5
COFFEYVILLE, CITY OF	81,997.18	23,655.74	105,652.92	5
COFFEYVILLE, CITY OF	53,919.25	28,687.00	82,606.25	3
COFFEYVILLE, CITY OF	77,740.60	19,149.60	96,890.20	4
WICHITA, CITY OF	138,823.70	25,853.88	164,677.58	2
FAIRWAY, CITY OF	65,022.27	9,801.87	74,824.14	5
Totals	**770,034.97**	**216,971.18**	**987,006.15**	**29**

Other methods to model flood vulnerability will be available as this plan matures and as better digital floodplains become available such as Digital Flood Insurance Rate maps (DFIRM). GIS overlays of DFIRMs on building inventory layers (such as HAZUS-MH Census Block based inventory) could be used to better quantify the risk by county. The state may consider using FEMA's HAZUS-MH flood loss modeling capabilities to further define the potential losses in high risk counties.

Development in Hazard-Prone Areas

Continuing land development in certain areas of Kansas could place more people and property in flood-prone areas, unless floodplain management is implemented. Note that some of the highest risk flood counties are also experiencing the greatest development pressures. Many of these counties experienced significant gains in housing units between 2000 and 2009 (see Tables 3.10 and 3.11). These counties include Johnson, Sedgwick, Douglas, Shawnee, and Leavenworth. It is not known how much development is occurring in flood hazard areas, but since all of these counties participate in the NFIP, any development in the floodplain should be built according to its corresponding floodplain management ordinance. This requires first floor elevations to be a minimum of one foot above the base flood elevation according to the state's minimum standards. It is worth noting again that the cities of Olathe and Shawnee in Johnson County, Topeka in Shawnee County, and Lawrence in Douglas County are part of the CRS, and thus have their floodplain management practices reviewed on a periodic cycle, typically every five years.

3.3.8 Fog

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
1.60	22 of 22	Low

Description
Fog results when air is cooled to the point that it can no longer hold all of the water vapor it contains. For example, rain can cool and moisten the air near the surface until fog forms (precipitation fog). A cloud-free, humid air mass at night can lead to fog formation, where land and water surfaces that have warmed up during the summer are still evaporating a lot of water into the atmosphere (radiation fog). A warm moist air mass blowing over a cold surface can also cause fog to form (advection fog).

In Kansas, fog is principally a threat to public safety. Of particular concern is the potential for multi-vehicle accidents on major highways in Kansas. These accidents can cause injuries and deaths and can have serious implications for health, safety, and environment if a hazardous or nuclear waste shipment is involved. Other disruptions from fog include delayed emergency response vehicle travel.

Location
Fog occurs statewide, but according to data from the National Climatic Data Center compiled by *USA Today*, western Kansas has more annual incidents of heavy fog (visibility is less than 1/4 mile) than the rest of the state.

Previous Occurrences
Generally, fog is a relatively common occurrence in Kansas, but fog events with significant adverse impacts are relatively rare. According to the National Climatic Data Center's Storm Events database, there were 37 fog events in Kansas between 1993 and 2010. These events caused $105,000 in damage, 5 deaths, and 25 injuries. All of the damage was attributable to three events:

- January 17, 2010 - An unusually long spell of periodic dense freezing fog persisted across much of the area from January 12th through the 19th. Fog was most dense during the nighttime and morning hours. The fog eventually led to two known injury (indirect) accidents across Barton and Reno Counties on the 17th and 18th.
- December 31, 2004— Dense fog covered a large area of east central Kansas and contributed to two multi-vehicle accidents between Ottawa and Pomona that killed one person and injured 8 others. Reports from the scene indicated visibility was around 100 feet.
- May 27, 2004— Dense fog resulted in two vehicle accidents in the Belleville area. Two vehicles collided at a road intersection when the driver of one of the vehicles apparently did not see a stop sign. Both vehicles suffered damage. The second accident occurred shortly after the first accident and near the same location when one vehicle entered the roadway near the first accident and was struck by another vehicle. In the second accident the vehicles also suffered damage and in addition a passenger in one of the vehicles was injured.

Other Fog Events
- December 24, 1994—Fog and icy road conditions contributed to a 38-car reaction collision on the Kansas Turnpike near El Dorado.

- July1, 2000 — Dense fog contributed to two fatal accidents (two deaths, three injuries) 10 miles west of Horton near the junction of U.S. Highway 75 and Highway 20.
- January 2001— Temperatures below freezing and dense fog combined to produce slick roads and poor visibility which resulted in a one-vehicle accident 2.5 miles west of McClouth that killed the female driver.
- March 12, 2007 — Dense fog formed over Dickinson County reducing visibilities to less than a quarter of a mile. An auto accident in the dense fog produced an indirect injury near Abilene.
- September 9, 2007 — Dense fog developed across Coffey and Anderson Counties in east central Kansas during the early morning hours of September 9th. Moisture pooled and winds sharply dropped off ahead of a weak cold frontal boundary, which helped the dense fog to develop. Once the cold front passed through the region, winds picked up out of the north and mixing helped lift the fog. Local law enforcement and storm spotters reported adverse driving conditions when visibilities were at their lowest. Fortunately, no accidents were reported.

Probability

According to data from the National Climatic Data Center compiled by *USA Today*, Kansas experiences at least 10-20 days of heavy fog (visibility is less than 1/4 mile) each year. Western Kansas experiences 20-40 days of heavy fog each year. An event causing significant damage occurs less frequently, thus, this hazard's CPRI probability is "**Possible**" within the next five years.

Vulnerability and Potential Losses by Jurisdiction

While western Kansas experiences more events, fog often settles in the floodplain valleys of eastern Kansas, where there is more population and more potential for a traffic accident. Interstate corridors across the state are at risk to mass transportation accidents triggered by fog.

Development in Hazard-Prone Areas

This is not a factor for consideration as fog can occur anywhere in the state.

3.3.9 Hailstorm

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.95	7 of 22	**Moderate**

Description

Hail covers the street in Hutchinson (Reno County)

Hailstorms in Kansas cause damage to property, crops, and the environment and kill and injure livestock. Because of Kansas' large agricultural industry, crop damage and livestock losses due to hail are of great concern to the state. In the United States, hail causes more than $1 billion in damage to property and crops each year. Over the 20-year period, 1989 to 2008, hurricanes and tropical storms made up 46.9% of total catastrophic losses, followed by tornado losses (27.0%), winter storms (7.6%), terrorism (6.9%), earthquakes and other geologic events (5.9%), wind/hail/flood (2.9%) and fire (2.4%). Civil disorders, water damage and utility services disruption combined represented less than 1%. Each year about 6% of homeowners file claims. Hail is associated with thunderstorms that can also bring high winds and tornadoes. It forms when updrafts carry raindrops into extremely cold areas of the atmosphere where they freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is pulled by gravity toward the earth.

Location

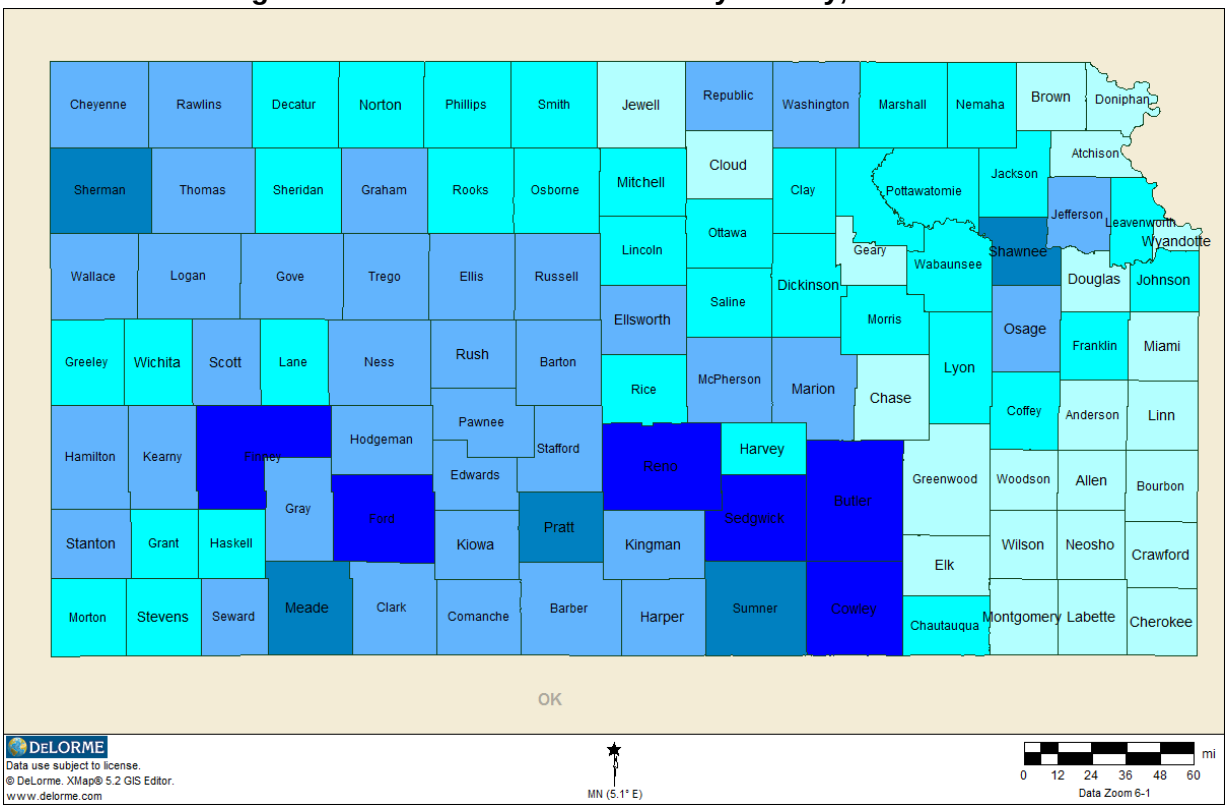
In Kansas, hail occurs statewide, but the risk in the western part of the state is somewhat elevated. This is due to more frequent hailstorms and the presence of significant crop lands, a dominant economic feature of the region.

More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences

According to the National Climatic Data Center's (NCDC) Storm Events database, there were 15,772 hail events and 99 hail-related injuries, when hail was at least one inch in diameter, between 1950 and 2010 (see Figure 3.36A). The events between 1950 and 2010 caused approximately $740.495 million in damage. This information suggests that Kansas could experience 263 one-inch-size hail events, $12 million in hail-related property and crop damage, and two hail-related injuries each year. (Data limitation: NCDC receives storm data from the National Weather Service (NWS), which receives information from a variety of sources, which include but are not limited to county, state, and federal emergency management officials, local law enforcement officials, Skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the general public. The hail events represent hail reports, not necessarily individual storms, and thus likely over count the actual number of hailstorms.)

Figure 3.36A. Kansas Hail Events by County, 1950–2010



Source: Bold Planning Solutions

	- 452 – 550 Events	High Risk Rating	-	7 Counties
	- 346 – 451 Events	Moderate Risk Rating	-	5 Counties
	- 240 – 345 Events	Low Risk Rating	-	35 Counties
	- 134 – 239 Events	Limited Risk Rating	-	23 Counties
	- 28 – 133 Events	No Risk Rating	-	35 Counties

Risk Rating Details: High, Moderate, and Low risk rankings are derived from historical hail events documentation at the local jurisdictional level. Jurisdictions that averaged 8 or more hail events a year received a high risk rating. Jurisdictions that averaged 5-7.9 hail events per year received a moderated risk rating. Jurisdictions that averaged 3-4.9 events a year received a low risk rating. Jurisdictions that average fewer than 3 events per year received a limited or no risk rating.

Notable Hail Events

- July 20, 2009 - A supercell moved southeast across northern and eastern portions of Harper County, producing a swath of golfball to baseball size hail and 60 to 70 mph winds from just east of Runnymede, southeast through the Danville and Freeport areas. A narrow swath of intense damage occurred, including uprooted trees, shattered car and building windows. At least three damaged irrigation systems, a damaged stock show trailer, structural and roof damage to several barns and homes, damage to various sheds and outbuildings, and devastating crop damage to soybeans, milo and corn occurred. Additionally, a camper trailer was thrown into a field near Danville, and a railroad crossing traffic barrier was blown down just east of Danville.

- June 12, 2009 - Hail was accompanied by 70 to 90 mph winds and did extensive damage to vehicles, buildings, crops and wildlife. The largest stones were a bit bigger than a baseball with the majority golfball sized. At one location two miles southeast of Cimarron the siding was stripped off a house. Many fields of alfalfa and wheat were completely mowed down by the wind and hail. Numerous rabbits and birds were lying dead where cover had once stood. Also, there were five pivot irrigation sprinklers overturned and several trees uprooted. Trees that were not uprooted were completely stripped of leaves and even pine trees were stripped of their needles in some cases.
- April 24, 2008 - Severe thunderstorms developed over NW Kansas during the early evening hours. One long-lived supercell moved slowly east across Sheridan and Graham Counties, producing baseball-sized hail and winds of 70-80 mph. Several grain bins were damaged or destroyed, hundreds of homes suffered broken windows on the north side of the dwellings, and minor power outages occurred.
- July 15, 2007 - Scattered thunderstorms rumbled across north-central Kansas during the evening hours. Some of the storms produced some hail up to the size of golf balls and winds around 60 mph.
- May 31, 2007 - Severe thunderstorms blasted through north-central Kansas. These storms produced hail, strong winds, and a brief tornado. Hail up to golf ball and baseball size was driven by winds of 60 to 70 mph. The worst damage was reported around the Smith Center area. A couple of outbuildings were destroyed in Smith Center and siding was damaged by the wind-driven hail. North of town, crops were stripped or mowed down by the hail.
- July 13, 2006—Baseball-sized hail and wind gusts to 65 mph damaged vehicles and crops in Jewell County around Burr Oak and Esbon.
- June 29, 2006—Severe crop damage was reported around Lebanon and Burr Oak as a result of quarter to golf-ball sized hail driven by 50+ mph winds. The worst damage occurred in a swath from four miles north of Lebanon to five miles north of Burr Oak, where fields of wheat, corn, and soybeans were totally destroyed.
- May 8-9, 2006—Numerous locations in southwest Kansas received golf ball sized hail. Hail drifts up to 18 inches deep were reported a few miles northeast of Hanston in Hodgeman County.
- April 24, 2006—An early morning severe thunderstorm pounded western and central portions of Sedgwick County with destructive hail as large as three inches in diameter. Widespread property damage to automobiles, homes, and businesses was reported across the Wichita area. Damage was estimated at $70 million.
- April 23, 2006—Large hail and straight-line winds were reported in northeast Kansas. Hail up to the size of tennis balls caused $4 million in damage to homes and vehicles in Lawrence.
- March 12, 2006—Hail up to the size of tennis balls in Burlingame caused considerable damage to homes and vehicles. Golf ball to tennis ball sized hail was also reported in Morris, Shawnee, Geary, Douglas, Jefferson, Pottawatomie and Wabaunsee Counties.
- June 30, 2005—Severe thunderstorms in Woodson County dropped baseball sized hail on farmland, causing an estimated $415,000 damage to crops.
- August 2002—Hail was reported as large as golf balls.
- May 2002—Hailstorm was severe enough for farmers in 33 counties to be eligible for emergency loans.
- May 16, 1999—A major storm hit Greeley, Wichita, Scott, and Lane Counties.
- 1991—A hailstorm hit Lawrence with walnut sized to golf ball sized hail.
- May 1977— A major storm hit Greeley, Wichita, Scott, and Lane Counties.

- September 3, 1970—The largest hailstone ever measured in Kansas (and, until recently, the United States) fell on Coffeyville, Kansas: 1.67 pounds and 17.5 inches in circumference.

Probability

According to the National Climatic Data Center Storm Events database, there were 15,772 hail events in Kansas between 1955 and 2010 (55 years). Based on this information, the probability that at least one hail event could occur in Kansas in any given year is 100%. Kansas can expect approximately $13,463,545 million in hail-related losses each year. This hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Hail Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years.		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

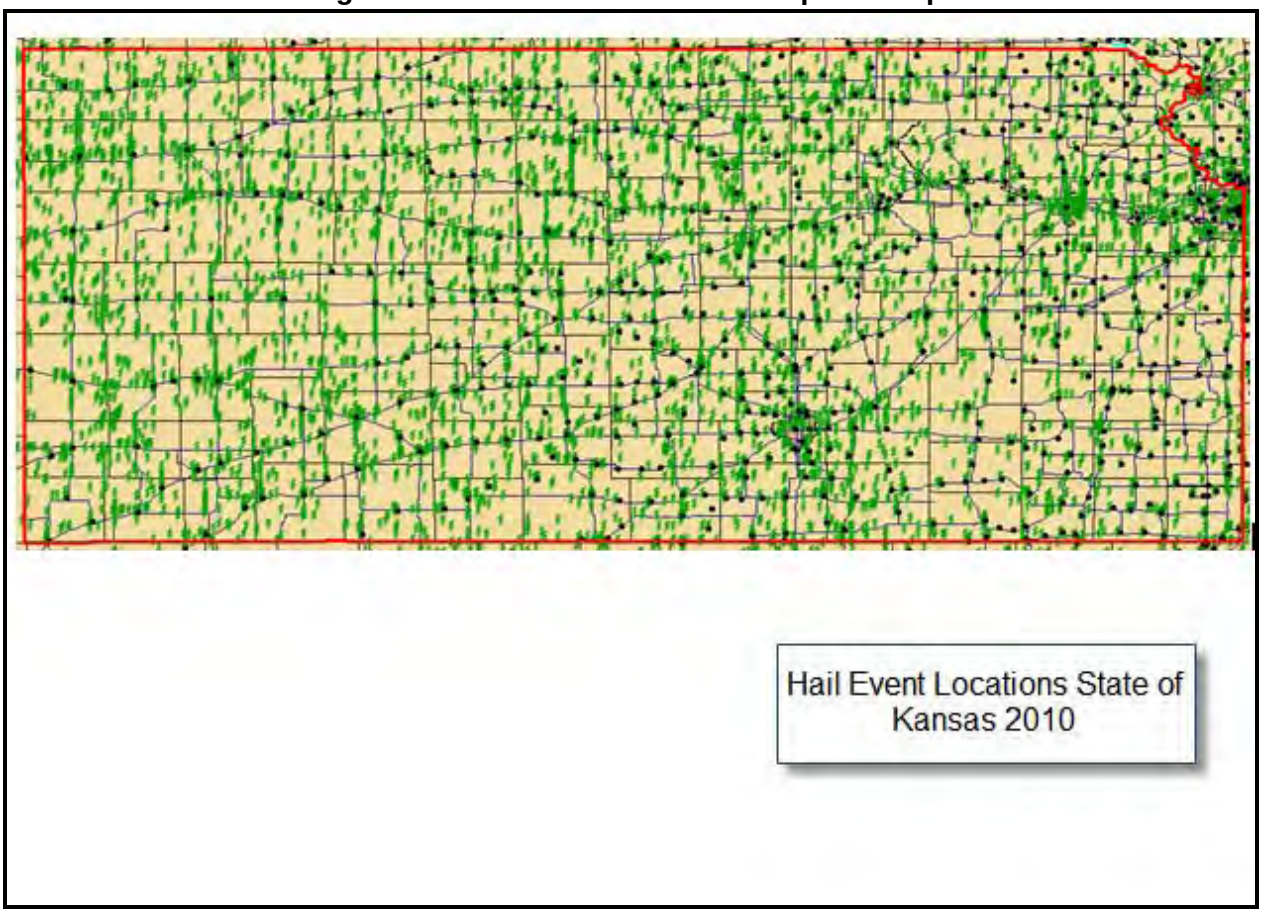
Urban vs. Rural/Farm Hail Probability Matrix

The probability and estimated damage of hail events differs in urban vs. rural environments. Please review the matrix below for specific details. Between 1993-2010, the State of Kansas has incurred 529 hail events that have produced reported crop damages totaling $220.404 million. In the same time period, 1993-2010, the State of Kansas has incurred 758 hail events that have produced $338.522 million in reported property damage.

Please reference matrix below:

Damage Type	Total Events 1993-2010	Total Damage Amounts	Average Amount Per Significant Event
Crop	529	$220.404 Million	$416,642.00
Property	758	$338.522 Million	$446,599.00

Figure 3.36B. Kansas Hail Events Spatial Map



Local Plan Integration

For the 2010 update, the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.38.

Table 3.38. Local Plan Statistics for Hail Events

County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	Low	105	$515,008.00	$2,042.00	N/A	N/A
Brown	High	116	$103,000.00	$400,000.00	0	0
Butler	Moderate	494	$7,964,086.00	$23,710.00	N/A	N/A
Chase	High	117	$10,000.00	$1,000,000.00	N/A	N/A
Cherokee	High	115	N/A	N/A	N/A	N/A
Cloud	High	27	$280,000.00	N/A	N/A	N/A
Cowley	Moderate	464	$329,000.00	$24,000.00	N/A	N/A
Crawford	Moderate	123	$23,000.00	N/A	N/A	N/A
Dickinson	Moderate	136	$1,300,000.00	$292,000.00	N/A	N/A
Douglas	High	25	$5,515,000.00	$515,000.00	N/A	N/A
Elk	Moderate	29	N/A	N/A	N/A	N/A
Ellsworth	High	244	$787,000.00	$880,000.00	N/A	N/A
Harper	Moderate	277	N/A	$1,737,457.00	N/A	N/A
Harvey	High	147	N/A	$136,134.00	N/A	N/A
Jewell	High	107	$1,195,000.00	$15,132,000.00	N/A	N/A
Johnson	Moderate	171	N/A	$11,164.00	N/A	N/A
Kingman	Moderate	271	$102,000.00	$1,870,000.00	N/A	N/A

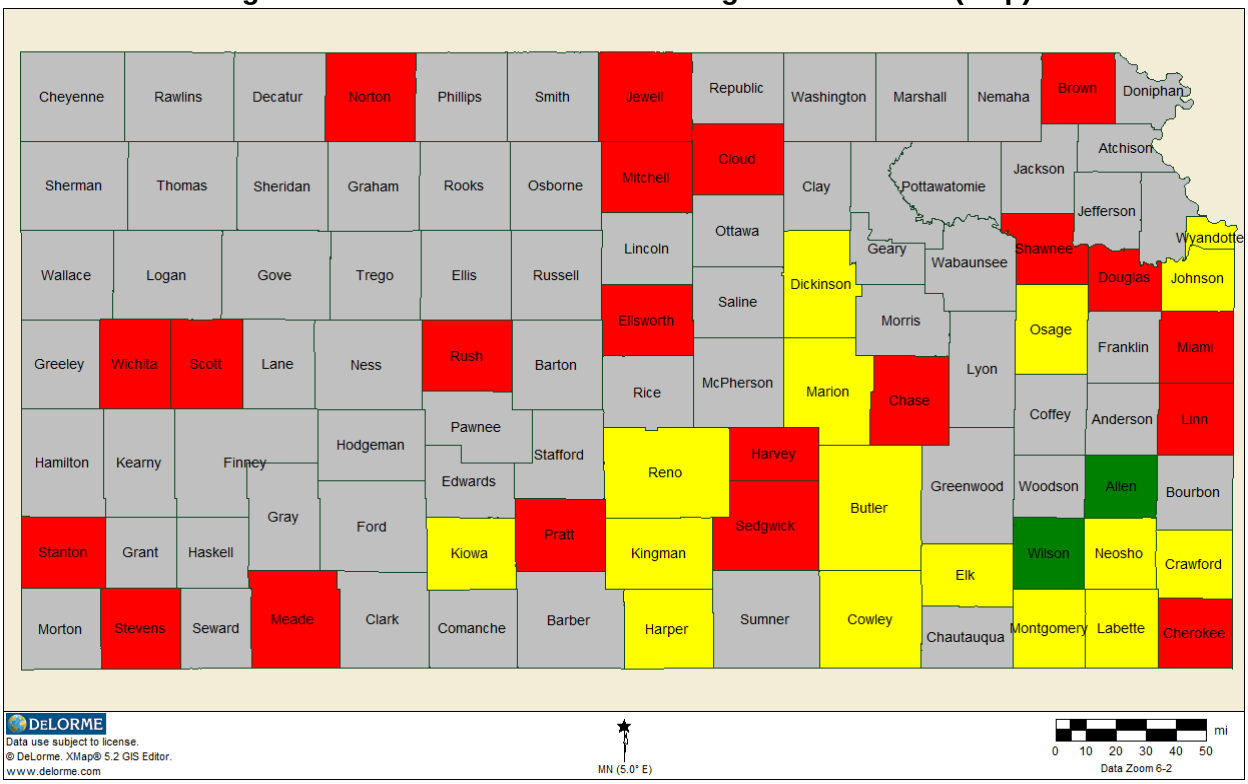
County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Kiowa	Moderate	251	N/A	N/A	N/A	N/A
Labette	Moderate	65	N/A	$51,025.00	N/A	N/A
Linn	High	N/A	N/A	N/A	N/A	N/A
Lyon	N/A	N/A	N/A	N/A	N/A	N/A
Marion	Moderate	N/A	N/A	N/A	N/A	N/A
Meade	High	348	$110,000.00	$110,000.00	N/A	N/A
Miami	High	123	$755,000.00	N/A	N/A	N/A
Mitchell	High	149	$1,003,550.00	$8,552,000.00	N/A	N/A
Montgomery	Moderate	87	N/A	N/A	N/A	N/A
Neosho	Moderate	113	$1,060,000.00	$41,000.00	N/A	N/A
Norton	High	184	$778,000.00	N/A	N/A	N/A
Osage	Moderate	256	$1,145,000.00	$80,000.00	N/A	N/A
Pratt	High	403	$195,000.00	N/A	N/A	N/A
Reno	Moderate	461	$13,845,000.00	$1,406,795.00	N/A	N/A
Rush	High	286	$3,792,000.00	$9,500,000.00	N/A	N/A
Scott	High	245	$660,000.00	$352,000.00	0	0
Sedgwick	High	771	$137,000,000.00	N/A	60	N/A
Shawnee	High	390	$635,000.00	$90,000.00	0	0
Stanton	High	245	N/A	$5,217,299.00	N/A	N/A
Stevens	High	213	$6,000.00	$500,000.00	0	0
Wichita	High	182	$815,000.00	$2,500,000.00	N/A	N/A
Wilson	Low	124	$13,497.00	$49,319.00	N/A	N/A
Wyandotte	Moderate	118	$15,650.00	$734.00	N/A	N/A
Total		**7982**	**$179,951,791.00**	**$50,473,679.00**	**60**	**0**

After reviewing the data from the local plans throughout the State of Kansas, the committee calculated averages for hail. As shown in the table located below, the state can expect an average of $28,868 in damages from a single hail event. This number can be misleading because a large portion of hail events are reported with no damages to the NCDC. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.39. Local Plan Averages for Hail

	Deaths	Injuries	Total Damages
Totals	0	60	$230,425,470
Average per County	0	1.5	$5,760,636
Average Per Event	0	0.008	$28,868

Figure 3.37. Local Plan Hazard Rating for Hailstorms (Map)



Source: Bold Planning Solutions

Red – High Risk Rating – 21 Jurisdictions
Yellow – Moderate Risk – 16 Jurisdictions
Green – Low Risk Rating – 2 Jurisdictions
Gray – No Plan / Rating – 66 Jurisdictions

Risk Ranking Details: High, Moderate, and Low risk rankings are derived from FEMA-approved Risk Assessment criteria for local mitigation plans across the State of Kansas. Based on their CPRI, the hazards were separated into three categories of planning significance: High (3.0-4.0), Moderate (2.0-2.95), and Low (1.1-1.95) at the local jurisdiction level. Please review entire CPRI ranking methodology on page 3.25.

Vulnerability and Potential Losses by Jurisdiction

Methodology

All 105 counties in Kansas are vulnerable to hailstorms. To refine and assess the relative vulnerability of each of Kansas' counties to hail, the state assigned ratings to five factors that were examined at the county level: prior events, building exposure, population density, percent farmland, and past hail damage. The state then summed the ratings to obtain overall vulnerability scores for each county so that they could be compared and the greatest vulnerability determined. The factors are described below.

Vulnerability Factors

Prior Events— This rating is based on the number of past hail events experienced by each county between 1955 and 2010 according to data from the National Climatic Data Center's Storm Events database. (Data limitation: NCDC receives storm data from the National Weather Service (NWS), which receives information from a variety of sources, which include but are not

limited to county, state, and federal emergency management officials, local law enforcement officials, Skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the general public. The hail events represent hail reports, not necessarily individual storms, and thus likely over count the actual number of hailstorms.)

To develop the prior event rating, the total range of past occurrences (28 to 550) was divided into 10 roughly equal ranges as shown in Table 3.40. The ranges were numbered 1 through 10 in ascending order. The ratings were defined based on the range of recorded hail occurrences per county.

Table 3.40. Prior Event Ratings

# of Past Occurrences	Rating
28 - 80	1
68 - 133	2
134 – 186	3
187 - 239	4
240 – 292	5
293 – 345	6
346 – 398	7
399 – 451	8
452 - 504	9
505 - 550	10

Building Exposure

To best compare the vulnerability of one county to another, it is necessary to consider assets vulnerable to loss. This rating is based on total building exposure from HAZUS-MH (residential, commercial, industrial, agricultural, religion, government, and education). The total range of building exposure ($94,973,000 to $ 36,434,134,000) was divided into 10 roughly equal ranges as shown in Table 3.41. The ranges were numbered 1 through 10 in ascending order.

Table 3.41. Building Exposure Ratings

Building Exposure ($000)	Rating
94,973 - 3,728,888	1
3,728,889 - 7,362,804	2
7,362,805 - 10,996,720	3
10,996,721 - 14,630,636	4
14,630,637 - 18,264,552	5
18,264,553 - 21,898,468	6
21,898,469 - 25,532,384	7
25,532,385 - 29,166,300	8
29,166,301 - 32,800,216	9
32,800,217 - 36,434,133	10

Population Density

Population density is determined by dividing a county's population by its land area (square miles). For this rating, 2010 U.S. Census Bureau population estimates were divided by the land area reported in the 2000 census. The total range of population densities (1.7 to 1,083.8 people

per square mile) was divided into 10 equal ranges as shown in Table 3.42. The ranges were numbered 1 through 10 in ascending order.

Table 3.42. Population Density Ratings

Population Density*	Rating
1.7 - 109.8	1
109.9 - 218	2
218.1 - 326.2	3
326.3 - 434.4	4
434.5 - 542.6	5
542.7 - 650.8	6
650.9 - 759	7
759.1 - 867.2	8
867.3 - 975.4	9
975.5 – 1,083.6	10
* People per square mile	

Percent Farmland

Percent farmland represents the percent of a county's acreage that is used for farming. For this rating, U.S. Department of Agriculture National Agricultural Statistics Service data were used. It was used to assess vulnerability to this hazard because of the importance of agriculture to the state and the potential of hail to cause severe economic damage to the sector. The total range of percent farmland (14.2 to 113.6) was divided into 10 roughly equal ranges as shown in Table 3.43. The ranges were numbered 1 through 10 in ascending order.

Table 3.43. Percent Farmland

Percent Farmland[1]	Rating
14.2 - 24	1
24.1 - 33.9	2
34 - 43.8	3
43.9 - 53.7	4
53.8 - 63.6	5
63.7 - 73.6	6
73.7 - 83.6	7
83.7 - 93.6	8
93.7 - 103.6	9
103.7 - 113.6	10

Past Hail Damage

This rating is based on the property damage for the hail events that occurred in Kansas between 1950 and 2010 as reported in the National Climatic Data Center's Storm Events database. This damage was presented in actual values for the year the events occurred. The state received $577 million in hail damage between 1950 and 2010, which averages out to approximately $41 million per year. The total range of past hail damage ($0 to $137,000,000) was divided into 10 roughly equal ranges as shown in Table 3.44. The ranges were numbered 1 through 10 in ascending order.

Table 3.44. Past Hail Damage Ratings

Past Hail Damage ($)	Rating
0 – 13,700,000	1
13,700,001 – 27,400,001	2
27,400,002 - 41,100,002	3
41,100,003 - 54,800,003	4
54,800,004 – 68,500,004	5
68,500,005 – 82,200,005	6
82,200,006 – 95,900,006	7
95,900,007 – 109,600,007	8
109,600,008 - 123,300,008	9
123,300,009 - 137,000,000	10

Each of the counties' ratings described above were added together to produce a county-level vulnerability rating using the five factor ratings. The highest possible total vulnerability rating was 40. The total range of vulnerability (10 to 40) was divided into three equal ranges as shown in Table 3.45. The ranges were assigned a corresponding level of hail vulnerability: moderate, high, and very high. The vulnerability scale begins at moderate, as every county has some degree of vulnerability.

Table 3.45 Hail Vulnerability

Hail Vulnerability Range	Hail Vulnerability
10 - 19	Moderate
20 - 29	High
30 - 40	Very High

Results
Vulnerability Factors
Summary of Prior Event Ratings

The lowest number of recorded hail events over this 60-year period was 28 in Doniphan County; the highest was 550 in Sedgwick County. All counties in Kansas experienced at least 28 hail events in the past 57 years. Sedgwick had by far the most and received a rating of 10. Ford County had the next highest number of events, 413, and was the only other county to receive a rating of 10. Seventy-two percent of the counties received ratings of 2 or 3. The counties that received a prior event rating greater than 3 are shown in Table 3.46.

Table 3.46. Counties with Prior Event Ratings Greater Than 3

County	# of Prior Events	Prior Event Rating
Sedgwick	550	10
Ford	413	10
Butler	331	8
Reno	317	8
Cowley	291	7
Sumner	290	7
Ellis	273	7
Shawnee	265	6
Finney	252	6

County	# of Prior Events	Prior Event Rating
Johnson	245	6
Pratt	237	6
Sherman	229	6
Russell	223	5
Barton	216	5
Comanche	206	5
Meade	201	5
Osage	193	5
Harper	183	4

The Total Hail Vulnerability and Estimate of Potential Loss section shows prior event ratings for all Kansas counties. A spreadsheet, which includes the corresponding values, can be found in Appendix G Kansas Hail Vulnerability.

Summary of Building Exposure Event Ratings

According to HAZUS-MH, the lowest building exposure was $94,973,000 in Wallace County; the highest was $36,434,134,000 in Johnson County. Johnson was the only county to receive a 10 rating. The next highest rating was 8 for Sedgwick County. The remainder of the counties received ratings between 1 and 3. Nearly 94% of the counties received a rating of 1. The counties that received a building exposure greater than 1 are shown in Table 3.47.

Table 3.47. Counties with Building Exposure Ratings Greater Than 1

County	Building Exposure ($000)	Building Exposure Rating
Johnson	36,434,134	10
Sedgwick	25,102,660	8
Wyandotte	9,588,275	3
Shawnee	9,560,755	3
Douglas	5,436,308	2
Leavenworth	4,133,644	2

A spreadsheet that includes the corresponding values can be found in Appendix G Kansas Hail Vulnerability.

Summary of Population Density Ratings

The lowest population density was 1.7 people per square mile in Wallace County; the highest was 1,083.8 people per square mile in Johnson County. Johnson, the most populous county in the state, and Wyandotte (population density 1,027.2), the fourth most populous county, were the only counties to receive a 10 rating and the only counties to receive a rating greater than 5. With a population density of 471.1 people per square mile, Sedgwick County is the third densest county and received the only 5 rating. More than 94% of the counties received a rating of 1. The counties that received a rating greater than 1 are listed in Table 3.48.

Table 3.48. Counties with Population Density Ratings Greater Than 1

County	Population Density*	Population Density Rating
Johnson	1,083.8	10
Wyandotte	1,027.2	10
Sedgwick	471.2	5
Shawnee	314.1	3
Douglas	245.4	3
Leavenworth	158.9	2
* People per square mile		

A spreadsheet that includes the corresponding values can be found in Appendix G Kansas Hail Vulnerability.

Summary of Percent Farmland

The county with the largest percent of its land in farming was Barton County with 113.6% in farmland. The county with the smallest percent of its land in farming was Wyandotte County with 14.2% in farmland. Acreage for the county and the county's farmland were determined by whole acres, leading some counties to exceed 100% in farmland. Totals were reported in tenths of acres were rounded to whole acres. Wyandotte was the only county to receive a rating of 1 and fewer than 4. Johnson was the only county to receive a 4 and the only other county, besides Wyandotte, to have less than 50% of its acreage in farmland. Eighty-five percent of the counties received ratings between 7 and 9. The counties that received a rating of 10 are listed in Table 3.49.

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Table 3.49. Counties with Farmland Ratings of 10

County	Percent Farmland	Farmland Rating
Barton	113.6	10
Haskell	109.9	10
Scott	107.9	10
Pawnee	107.8	10
Pratt	106.5	10
Edwards	105.5	10
Stevens	105.4	10

A spreadsheet, which includes the corresponding values, can be found in Appendix G Kansas Hail Vulnerability.

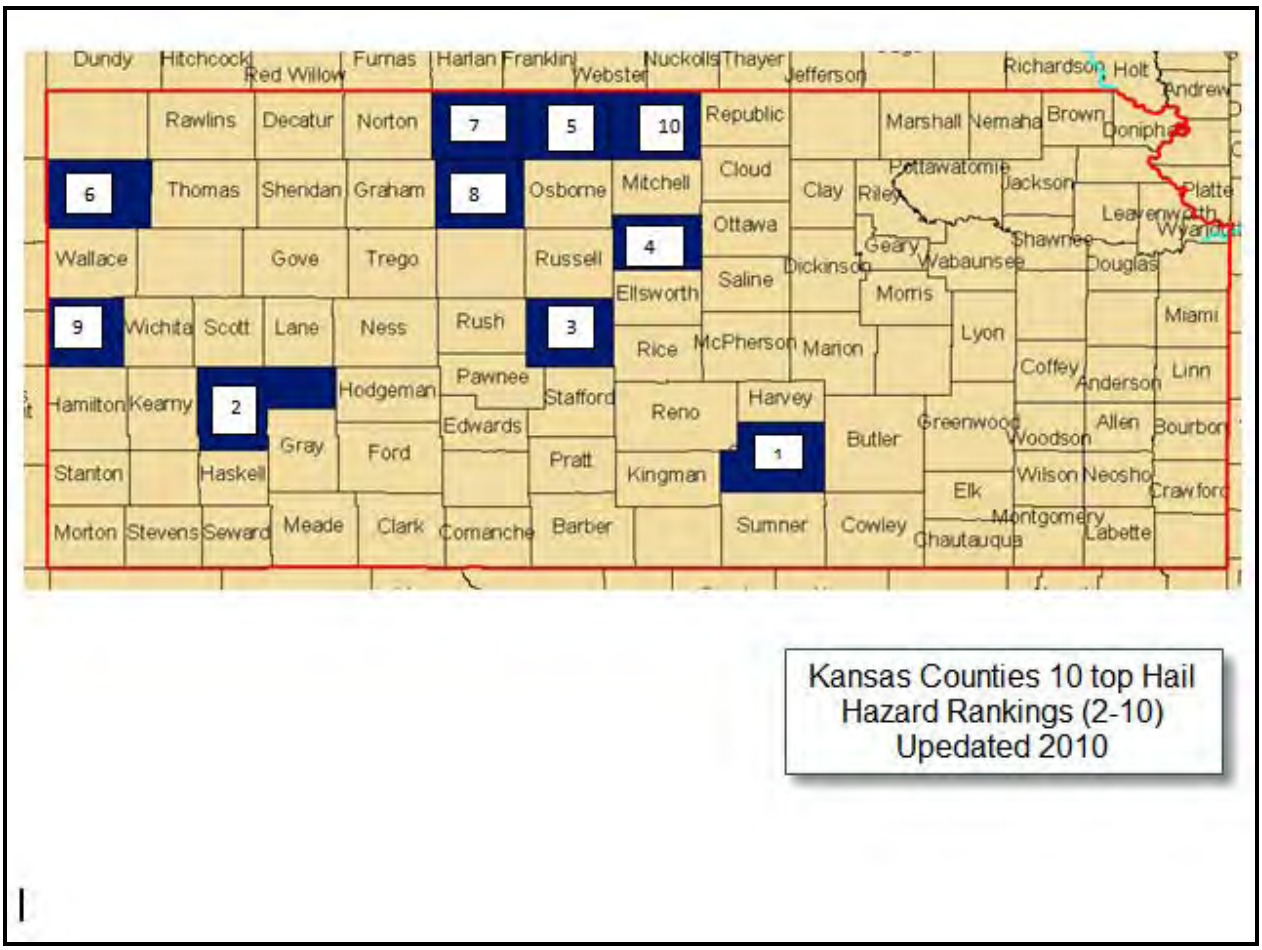
Summary of Past Hail Damage Ratings

Based on NCDC Data, during the 55-year period, Sedgwick County incurred the most hail damage: $243,436,534. Stafford, Graham, Kiowa, Grant, Bourbon, and Anderson Counties had the least. Sedgwick was the only county to receive a rating of 10. Finney County, with $78,884,363 in damages, received a rating of 5. The counties of Lincoln, Barton, Smith, Phillips, and Greeley received ratings of 2 while the other counties, 93%, received ratings of 1. Those counties that received a rating higher than 1 are listed in Table 3.50. Figure 3.38 shows the distribution of hail damage across the state between 1955 and 2010.

Table 3.50. Counties with Past Hail Damage Ratings Greater Than 1

County	Total Hail Damage ($)	Past Hail Damage Rating
Sedgwick	243,436,534	10
Finney	78,892,363	5
Barton	32,233,235	2
Lincoln	31,937,790	2
Smith	27,232,195	2
Sherman	26,236,000	2
Phillips	24,821,112	2
Rooks	18,545,000	2
Greeley	18,366,083	2
Jewell	16,879,000	2

Figure 3.38 Hail Damage Ranking by County 1955-2010

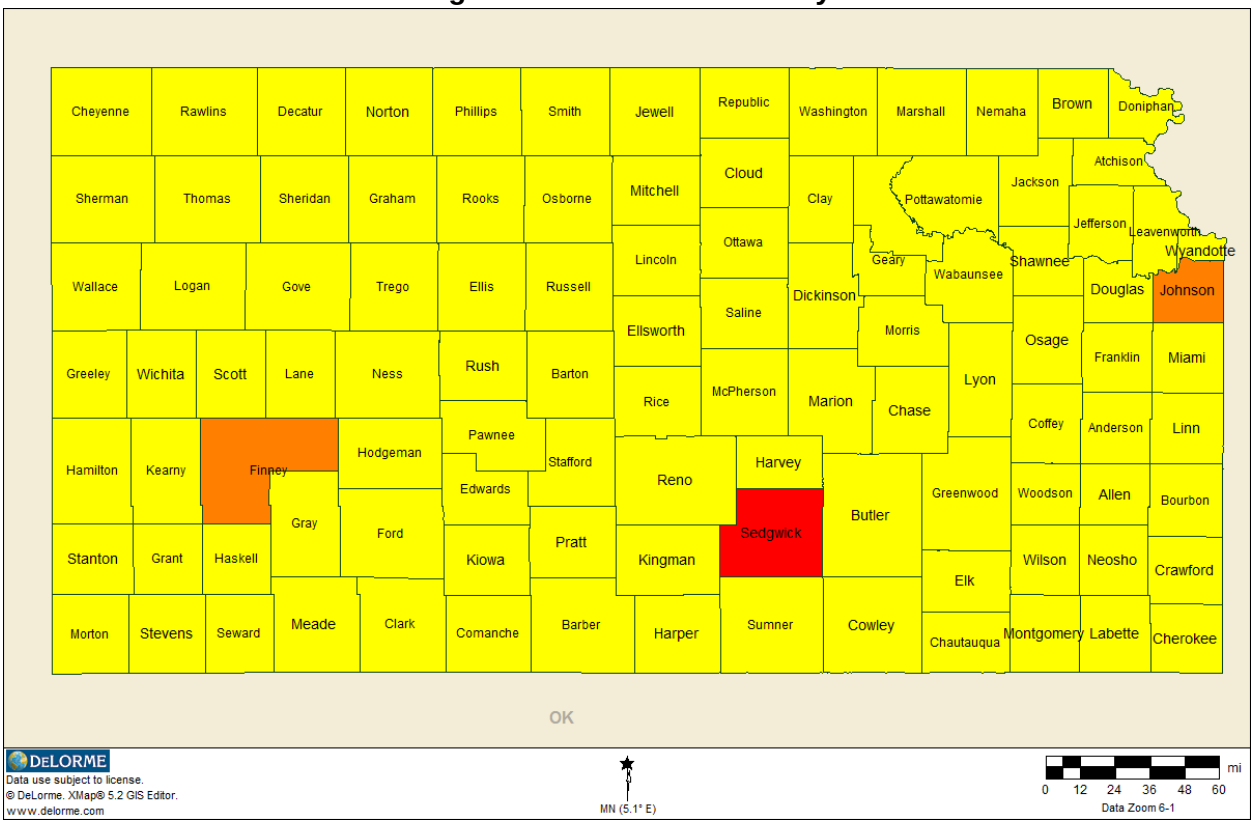


A spreadsheet, which includes the corresponding values, can be found in Appendix G Kansas Hail Vulnerability.

Total Hail Vulnerability and Estimate of Potential Loss

According to this methodology, while every Kansas county is vulnerable to hail, only Sedgwick has a very high vulnerability. Johnson and Finney Counties have high vulnerabilities. The remainder of the counties, 97%, have moderate vulnerabilities. Figure 3.39 illustrates the vulnerability of Kansas counties to hail, and Table 3.50 shows all the Kansas counties ranked by total hail vulnerability along with their five vulnerability factor ratings.

Figure 3.39. Hail Vulnerability



Source: Bold Planning Solutions

- **Very High Vulnerability**
- **High Vulnerability**
- **Moderate Vulnerability**

Table 3.51. Vulnerability of Kansas Counties to Hail (ranked by vulnerability)

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Farmland Rating	Past Hail Damage Rating	Total Rating	Hail Vulnerability
Sedgwick	10	8	5	7	10	40	Very High
Johnson	3	10	10	4	1	29	High
Finney	9	1	1	9	5	20	High
Barton	6	1	1	10	3	18	Moderate
Ford	10	1	1	8	1	18	Moderate
Pratt	8	1	1	10	1	18	Moderate
Shawnee	7	3	3	5	1	18	Moderate
Sumner	8	1	1	9	1	18	Moderate
Cowley	9	1	1	9	1	17	Moderate
Reno	9	1	1	8	2	17	Moderate
Wyandotte	2	3	10	1	1	17	Moderate
Butler	9	1	1	7	1	16	Moderate
Edwards	5	1	1	10	1	16	Moderate
Ellis	6	1	1	9	1	16	Moderate
Meade	7	1	1	9	1	16	Moderate
Pawnee	6	1	1	10	1	16	Moderate
Scott	5	1	1	10	1	16	Moderate
Sherman	7	1	1	8	2	16	Moderate
Barber	3	1	1	9	1	15	Moderate
Cloud	3	1	1	9	1	15	Moderate
Comanche	4	1	1	8	1	15	Moderate
Dickinson	3	1	1	9	1	15	Moderate
Douglas	3	2	3	6	1	15	Moderate
Harper	4	1	1	8	1	15	Moderate
Harvey	3	1	1	9	1	15	Moderate
Haskell	3	1	1	10	1	15	Moderate
Jewell	3	1	1	8	2	15	Moderate
Kearny	3	1	1	9	1	15	Moderate
Kingman	3	1	1	9	1	15	Moderate
Kiowa	3	1	1	9	1	15	Moderate
Lincoln	2	1	1	9	2	15	Moderate
McPherson	3	1	1	9	1	15	Moderate
Ness	3	1	1	9	1	15	Moderate
Phillips	2	1	1	9	2	15	Moderate
Rawlins	3	1	1	9	1	15	Moderate
Rooks	2	1	1	9	2	15	Moderate
Russell	4	1	1	8	1	15	Moderate
Saline	3	1	1	9	1	15	Moderate
Stevens	2	1	1	10	1	15	Moderate
Thomas	3	1	1	9	1	15	Moderate
Cheyenne	3	1	1	8	1	14	Moderate
Clay	2	1	1	9	1	14	Moderate
Ellsworth	3	1	1	8	1	14	Moderate

Gove	3	1	1	8	1	14	Moderate
Graham	3	1	1	8	1	14	Moderate
Gray	3	1	1	8	1	14	Moderate
Greeley	2	1	1	8	2	14	Moderate
Hamilton	3	1	1	8	1	14	Moderate
Lane	2	1	1	9	1	14	Moderate
Logan	3	1	1	8	1	14	Moderate
Marion	2	1	1	9	1	14	Moderate
Marshall	2	1	1	9	1	14	Moderate
Mitchell	2	1	1	9	1	14	Moderate
Osage	4	1	1	7	1	14	Moderate
Ottawa	3	1	1	8	1	14	Moderate
Pottawatomie	3	1	1	8	1	14	Moderate
Republic	3	1	1	8	1	14	Moderate
Rush	3	1	1	8	1	14	Moderate
Smith	2	1	1	8	2	14	Moderate
Stafford	3	1	1	8	1	14	Moderate
Stanton	2	1	1	9	1	14	Moderate
Washington	3	1	1	8	1	14	Moderate
Wichita	2	1	1	9	1	14	Moderate
Anderson	1	1	1	9	1	13	Moderate
Chautauqua	1	1	1	9	1	13	Moderate
Clark	3	1	1	7	1	13	Moderate
Decatur	3	1	1	7	1	13	Moderate
Franklin	2	1	1	8	1	13	Moderate
Hodgeman	2	1	1	8	1	13	Moderate
Jefferson	3	1	1	7	1	13	Moderate
Labette	2	1	1	8	1	13	Moderate
Leavenworth	2	2	2	6	1	13	Moderate
Lyon	2	1	1	8	1	13	Moderate
Miami	2	1	1	8	1	13	Moderate
Montgomery	2	1	1	8	1	13	Moderate
Morris	2	1	1	8	1	13	Moderate
Nemaha	2	1	1	8	1	13	Moderate
Neosho	2	1	1	8	1	13	Moderate
Norton	2	1	1	8	1	13	Moderate
Osborne	2	1	1	8	1	13	Moderate
Rice	2	1	1	8	1	13	Moderate
Seward	2	1	1	8	1	13	Moderate
Sheridan	2	1	1	8	1	13	Moderate
Trego	3	1	1	7	1	13	Moderate
Wabaunsee	2	1	1	8	1	13	Moderate
Wilson	2	1	1	8	1	13	Moderate
Allen	1	1	1	8	1	12	Moderate
Brown	1	1	1	8	1	12	Moderate
Crawford	1	1	1	8	1	12	Moderate
Elk	1	1	1	8	1	12	Moderate
Grant	2	1	1	7	1	12	Moderate
Greenwood	2	1	1	7	1	12	Moderate

Morton	2	1	1	7	1	12	Moderate
Wallace	3	1	1	6	1	12	Moderate
Atchison	1	1	1	7	1	11	Moderate
Bourbon	1	1	1	7	1	11	Moderate
Cherokee	1	1	1	7	1	11	Moderate
Coffey	1	1	1	7	1	11	Moderate
Doniphan	1	1	1	7	1	11	Moderate
Geary	2	1	1	6	1	11	Moderate
Jackson	1	1	1	7	1	11	Moderate
Linn	1	1	1	7	1	11	Moderate
Riley	3	1	1	5	1	11	Moderate
Woodson	1	1	1	7	1	11	Moderate
Chase	1	1	1	6	1	10	Moderate

Figure Differential Description:

Figures 3.3.7 and 3.3.8 do not correspond as they are created from different data compilations. Figure 3.3.7 is compiled from NCDC total property damage totals per county from past hail events. Figure 3.38 is compiled from hail vulnerability rankings. These rankings were based on a weighted average of the following:

- Building Exposure Rating
- Population Density Rating
- Farmland Rating

To estimate potential losses to hailstorms, historic loss data was analyzed. According to the National Climatic Data Center's Storm Events database, there were 15,772 hail events and 99 hail-related injuries, when hail was at least one inch, between 1950 and 2010. The events between 1993 and 2010 caused over $734 million in damage. This information suggests that Kansas could experience 235 one-inch-size hail events, $13,463,545 in hail-related property and crop damage each year, and 2 hail-related injuries. The total historic losses and annualized losses by county are presented in Table 3.52 based on data from 1993-2010.

Table 3.52. Annualized Losses from Hail (1993–2010)

County	Damages (Prop)	Annual Property Damage	Damages (Crop)	Annual Crop Damage	Total Losses	Total Annual Losses
Anderson	$0.00	$0.00	$5,000.00	$83.33	$5,000.00	$83.33
Atchison	$131,000.00	$2,183.33	$1,300,000.00	$21,666.67	$1,431,000.00	$23,850.00
Barber	$50,000.00	$833.33	$500,000.00	$8,333.33	$550,000.00	$9,166.67
Barton	$21,538,000.00	$358,966.67	$6,075,000.00	$101,250.00	$27,613,000.00	$460,216.67
Bourbon	$2,012,000.00	$33,533.33	$10,000.00	$166.67	$2,022,000.00	$33,700.00
Chatauqua	$7,000.00	$116.67	$2,000.00	$33.33	$9,000.00	$150.00
Cheyenne	$71,000.00	$1,183.33	$250,000.00	$4,166.67	$321,000.00	$5,350.00
Clark	$2,234,000.00	$37,233.33	$150,000.00	$2,500.00	$2,384,000.00	$39,733.33
Clay	$133,000.00	$2,216.67	$164,000.00	$2,733.33	$297,000.00	$4,950.00

Coffey	$1,020,000.00	$17,000.00	$34,000.00	$566.67	$1,054,000.00	$17,566.67
Comanche	$1,514,000.00	$25,233.33	$1,145,000.00	$19,083.33	$2,659,000.00	$44,316.67
Decatur	$6,000.00	$100.00	$550,000.00	$9,166.67	$556,000.00	$9,266.67
Doniphan	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Edwards	$500,000.00	$8,333.33	$0.00	$0.00	$500,000.00	$8,333.33
Ellis	$2,220,000.00	$37,000.00	$3,800,000.00	$63,333.33	$6,020,000.00	$100,333.33
Finney	$58,163,000.00	$969,383.33	$750,000.00	$12,500.00	$58,913,000.00	$981,883.33
Ford	$11,847,000.00	$197,450.00	$125,000.00	$2,083.33	$11,972,000.00	$199,533.33
Franklin	$1,263,000.00	$21,050.00	$65,000.00	$1,083.33	$1,328,000.00	$22,133.33
Geary	$271,000.00	$4,516.67	$475,000.00	$7,916.67	$746,000.00	$12,433.33
Gove	$5,656,000.00	$94,266.67	$45,000.00	$750.00	$5,701,000.00	$95,016.67
Graham	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Grant	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gray	$1,200,000.00	$20,000.00	$0.00	$0.00	$1,200,000.00	$20,000.00
Greeley	$950,000.00	$15,833.33	$13,105,000.00	$218,416.67	$14,055,000.00	$234,250.00
Greenwood	$25,000.00	$416.67	$3,000.00	$50.00	$28,000.00	$466.67
Hamilton	$96,000.00	$1,600.00	$50,000.00	$833.33	$146,000.00	$2,433.33
Haskell	$78,000.00	$1,300.00	$50,000.00	$833.33	$128,000.00	$2,133.33
Hodgeman	$2,000.00	$33.33	$0.00	$0.00	$2,000.00	$33.33
Jackson	$100,000.00	$1,666.67	$501,000.00	$8,350.00	$601,000.00	$10,016.67
Jefferson	$1,185,000.00	$19,750.00	$580,000.00	$9,666.67	$1,765,000.00	$29,416.67
Kearny	$570,000.00	$9,500.00	$50,000.00	$833.33	$620,000.00	$10,333.33
Lane	$1,840,000.00	$30,666.67	$750,000.00	$12,500.00	$2,590,000.00	$43,166.67
Leavenworth	$1,075,000.00	$17,916.67	$500,000.00	$8,333.33	$1,575,000.00	$26,250.00
Lincoln	$186,000.00	$3,100.00	$25,835,000.00	$430,583.33	$26,021,000.00	$433,683.33
Logan	$207,000.00	$3,450.00	$1,050,000.00	$17,500.00	$1,257,000.00	$20,950.00
Marshall	$44,000.00	$733.33	$160,000.00	$2,666.67	$204,000.00	$3,400.00
McPherson	$116,000.00	$1,933.33	$16,000.00	$266.67	$132,000.00	$2,200.00
Mitchell	$1,003,550.00	$16,725.83	$8,552,000.00	$142,533.33	$9,555,550.00	$159,259.17
Morris	$909,000.00	$15,150.00	$139,000.00	$2,316.67	$1,048,000.00	$17,466.67
Morton	$260,000.00	$4,333.33	$0.00	$0.00	$260,000.00	$4,333.33
Nemaha	$112,000.00	$1,866.67	$750,000.00	$12,500.00	$862,000.00	$14,366.67
Ness	$1,303,000.00	$21,716.67	$1,750,000.00	$29,166.67	$3,053,000.00	$50,883.33
Osborne	$2,748,000.00	$45,800.00	$11,677,000.00	$194,616.67	$14,425,000.00	$240,416.67
Ottawa	$120,000.00	$2,000.00	$6,881,000.00	$114,683.33	$7,001,000.00	$116,683.33
Pawnee	$115,000.00	$1,916.67	$0.00	$0.00	$115,000.00	$1,916.67
Phillips	$2,738,000.00	$45,633.33	$20,475,000.00	$341,250.00	$23,213,000.00	$386,883.33
Pottawatomie	$66,000.00	$1,100.00	$5,000.00	$83.33	$71,000.00	$1,183.33
Rawlins	$353,000.00	$5,883.33	$500,000.00	$8,333.33	$853,000.00	$14,216.67
Republic	$121,000.00	$2,016.67	$221,000.00	$3,683.33	$342,000.00	$5,700.00
Rice	$1,011,000.00	$16,850.00	$520,000.00	$8,666.67	$1,531,000.00	$25,516.67
Riley	$400,000.00	$6,666.67	$0.00	$0.00	$400,000.00	$6,666.67
Rooks	$1,469,000.00	$24,483.33	$17,076,000.00	$284,600.00	$18,545,000.00	$309,083.33
Russell	$58,000.00	$966.67	$7,000.00	$116.67	$65,000.00	$1,083.33

Saline	$1,405,000.00	$23,416.67	$5,000.00	$83.33	$1,410,000.00	$23,500.00
Seward	$2,200,000.00	$36,666.67	$0.00	$0.00	$2,200,000.00	$36,666.67
Sheridan	$838,000.00	$13,966.67	$200.00	$3.33	$838,200.00	$13,970.00
Sherman	$12,686,000.00	$211,433.33	$13,550,000.00	$225,833.33	$26,236,000.00	$437,266.67
Smith	$1,280,000.00	$21,333.33	$22,440,000.00	$374,000.00	$23,720,000.00	$395,333.33
Stafford	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Sumner	$3,034,000.00	$50,566.67	$15,000.00	$250.00	$3,049,000.00	$50,816.67
Thomas	$55,000.00	$916.67	$5,500,000.00	$91,666.67	$5,555,000.00	$92,583.33
Trego	$35,000.00	$583.33	$5,500,000.00	$91,666.67	$5,535,000.00	$92,250.00
Wabaunsee	$402,000.00	$6,700.00	$42,000.00	$700.00	$444,000.00	$7,400.00
Wallace	$5,056,000.00	$84,266.67	$5,500,000.00	$91,666.67	$10,556,000.00	$175,933.33
Washington	$18,000.00	$300.00	$10,000.00	$166.67	$28,000.00	$466.67
Woodson	$97,000.00	$1,616.67	$437,000.00	$7,283.33	$534,000.00	$8,900.00
Totals	**$156,202,550.00**	**$2,603,375.84**	**$179,647,200.00**	**$2,994,119.99**	**$335,849,750.00**	**$5,597,495.83**

Development in Hazard-Prone Areas

Growth in the state is exposing more people and property to the hail hazard, notably in eastern Kansas.

3.3.10 Hazardous Materials

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.90	9 of 22	**Moderate**

Description

Hazardous materials and waste are a concern for Kansas because a sudden accidental or intentional release (see Section 3.3.17 Terrorism, Agri-Terrorism, and Civil Disorder) of such materials can be dangerous to human health and safety, to property, and to the quality of the environment. Such releases may come from both fixed sources, such as a manufacturing or storage facility, or from a transportation source, such as a truck or pipeline. Accidental releases may be due to equipment failure, human error, or a natural or manmade hazard event.

Agricultural facilities throughout Kansas are likely to have dangerous materials present that could pose a threat to surrounding populations in the event of an emergency or disaster. Facilities that store or use chemicals considered unusually dangerous to human safety are required by Section 112R of the Clear Air Act Amendments to assess the potential impacts of an accidental release of the chemical at their facility and to prepare risk management plans (RMP). Of particular interest to Kansas is that ammonia is one of the covered hazardous materials. Numerous Kansas ammonia storage and distribution facilities have filed an RMP with the U.S. Environmental Protection Agency (EPA). A database with information about Kansas facilities that have RMPs is available through the EPA at www.rtknet.org/rmp/KS.php.

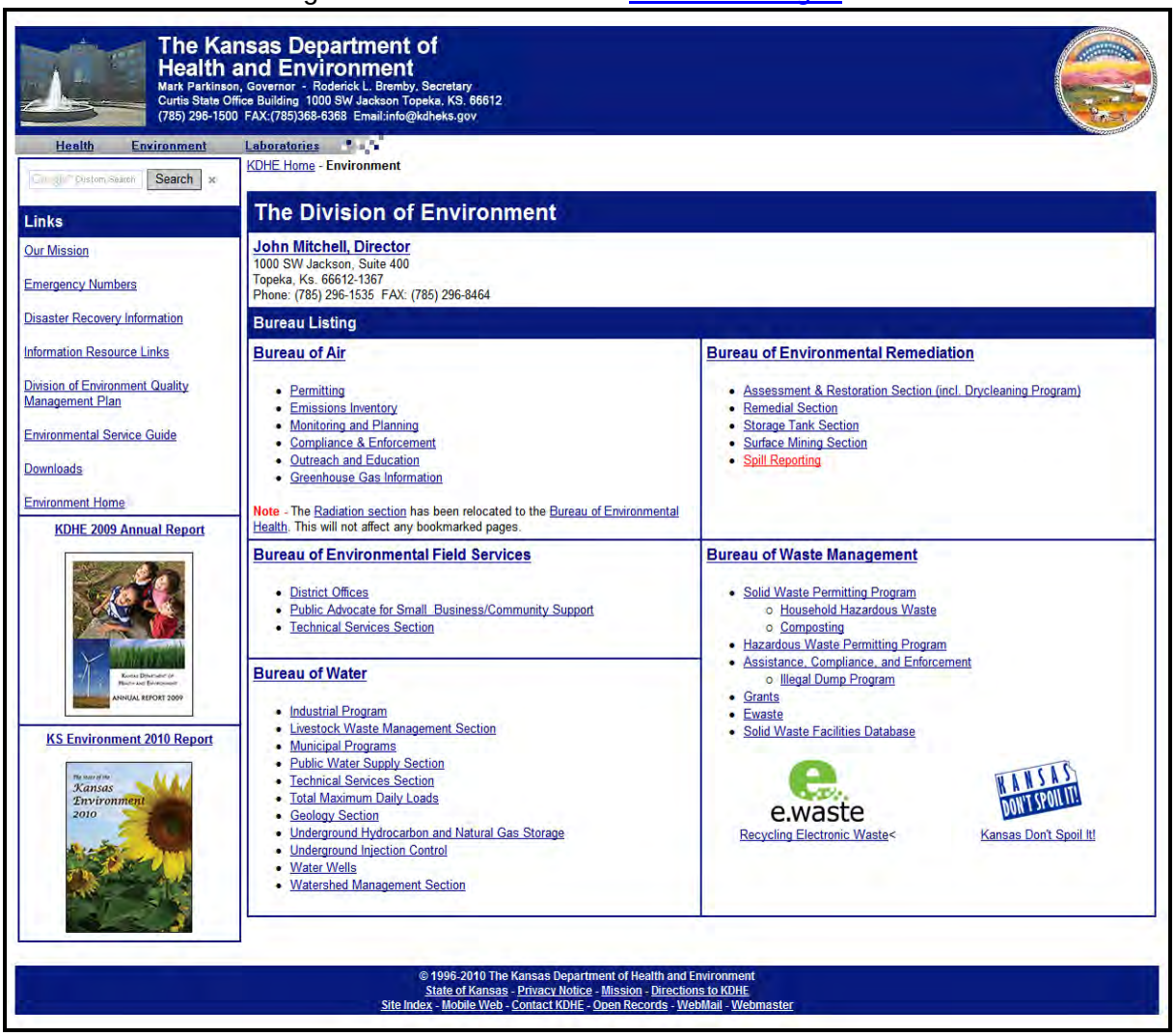
Also of concern in Kansas are caverns in the salt beds, which are used for storing natural gas, natural gas liquids, and other hydrocarbons. Some caverns that are now used for hydrocarbon storage were originally created during salt mining; others were created by solutions specifically for the storage of hydrocarbons. Salt caverns are used for storage because salt is highly impermeable, and salt beds in Kansas are thick and fairly predictable. Nevertheless, there are problems associated with such storage, such as the potential for natural leakage, cavern failure, and equipment failure, which can result in fires and explosions.

For more information on hydrocarbon storage sites in Kansas, please reference the Kansas Response Plan, ESF 10. (The Kansas Response Plan is not added as an appendix to this mitigation plan for security protocols.) The primary agency responsible for Hazardous Materials within the State of Kansas is the Kansas Department of Health and Environment.
The agency:

- Coordinates identification of facilities using SARA Title III and Tier II information;
- Develops plans for communications, warning and public information;
- Develops procedures for identification, control and clean-up of incidents;
- Provides, obtains or recommends training for response personnel;

- Maintains a list of private contractors capable of performing emergency and/or remedial actions associated with a Hazardous Materials incident.

Specific details concerning specific hydrocarbon storage site locations, as well as past events can be referenced through the KDEKS website at www.kdheks.gov.



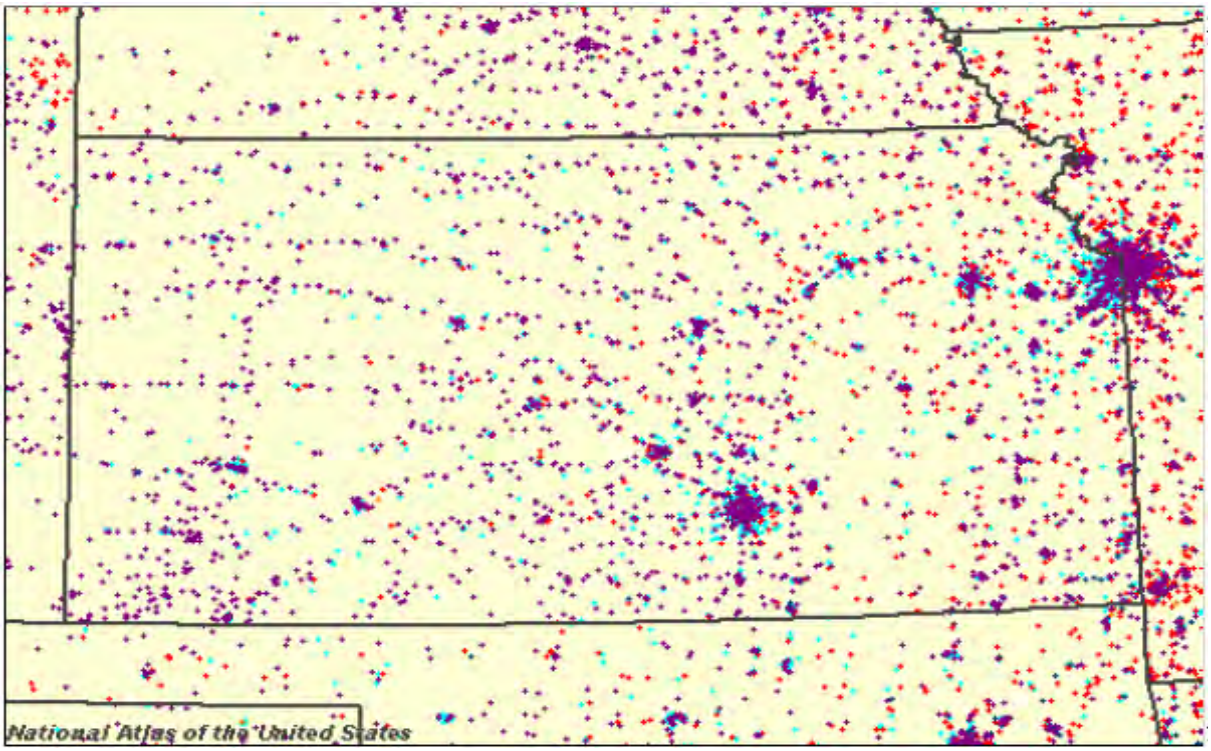
Location

Hazardous materials pose a threat to communities in all areas of Kansas. Localities where hazardous materials are fabricated, processed, and stored as well as those where hazardous waste is treated, stored, and disposed of are most at risk for hazardous materials incidents. Additionally, localities along transportation corridors that carry these materials to their final destinations are also at risk.

The KHMT considers the risk level from hazardous materials accidents to be relatively low in the northwestern part of the state, because of the lesser level of development and industrialization of this area. The risk is more elevated, but still relatively low, in the north central, southeastern, and southwestern regions of Kansas. A more moderate risk is considered to be present in the northeast region of the state, reflecting the development and industrialization of the Kansas City metropolitan area, as well as in the south central region of the state, again reflecting the development and industrialization in the Wichita metropolitan area.

Generally, it is the developed areas or environmental resources in the immediate vicinity of facilities or transportation routes that would be at risk. Figure 3.39 shows four types of fixed locations that may be of concern regarding the accidental or intentional release of hazardous materials: facilities with permitted air releases, hazardous waste sites, and facilities permitted to release toxic materials, and facilities permitted to discharge chemicals into surface waters.

Figure 3.40. Locations of Hazardous Materials Release Points



Purple—Air Releases
Light Blue—Hazardous Waste Handlers
Dark Blue—Toxic Resource Inventory
Red—Water Discharge Permits
Sources: U.S. Environmental Protection Agency May 2005, map generated by National Atlas of the United States, www.nationalatlas.gov

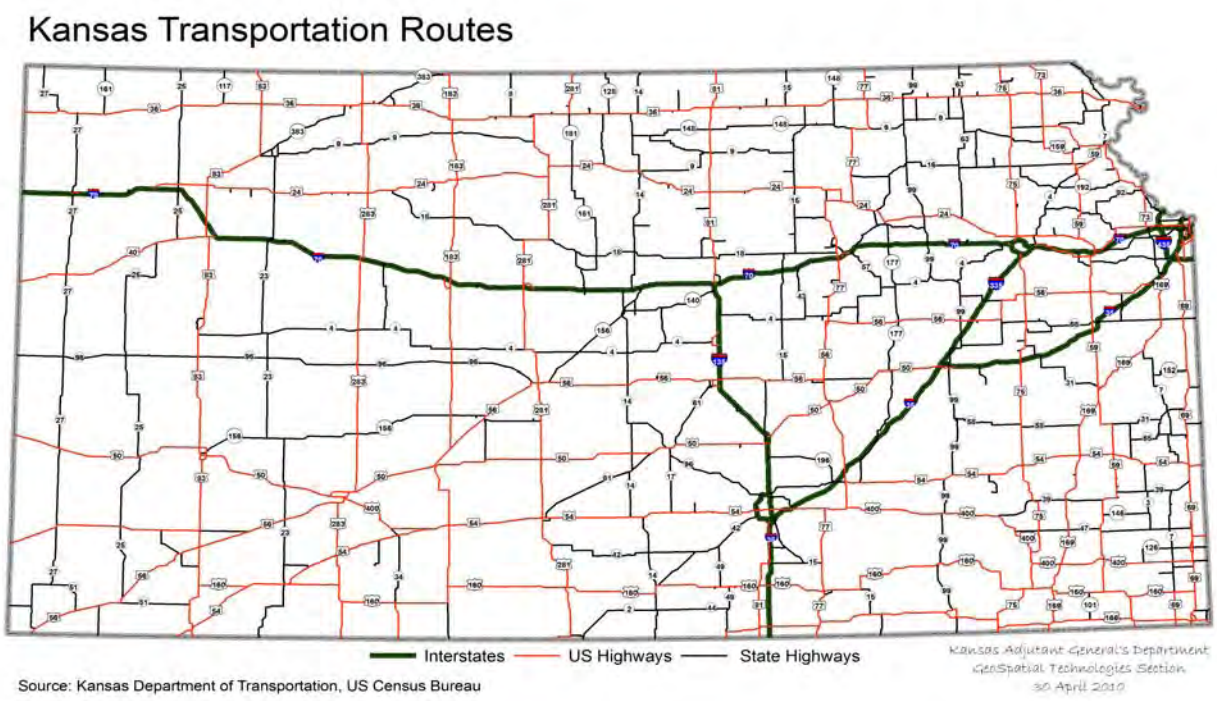
The map above has not been updated by the EPA at the time of the 2010 revision.

Kansas has more subsurface hydrocarbon storage caverns than any other state. Subsurface hydrocarbon storage occurs in Rice, Reno, McPherson, Kingman, Grant and Ellsworth Counties.

Transportation

Figure 3.41 illustrates the size, location, and complexity of Kansas' transportation infrastructure.

Figure 3.41. Transportation Infrastructure in Kansas



Sources: U.S. Geological Survey, Federal Aviation Administration, mapped by the National Atlas of the United States, www.nationalatlas.gov

Pipelines

According to the U.S. Department of Transportation's Office of Pipeline Safety, Kansas' pipeline system is as follows:

Table 3.53. Statewide Pipeline Mileage

Pipeline Mileage Overview	
Pipeline System	**Mileage**
Hazardous liquid line mileage	9,476
Gas transmission line mileage	14,692
Gas Gathering line mileage	194
Gas distribution mileage (938,451 total services *	21,933
Total pipeline mileage	46,295

All mileages are for 2010 and are approximate as some data sources may not have contained a complete record of state pipeline mileage.

*Gas distribution service lines (the connection between the distribution line and the end user) are not included in the gas distribution mileage. The total mileage of such service lines is 884,125.

Table 3.54 shows the breakdown of gas transmission line and hazardous liquid line mileage by county. Figures 3.42 and 3.43 show the location of the state's gas and petroleum lines.

Table 3.54. Gas Transmission Line and Hazardous Liquid Line Mileage by County as of March 2010 (ranked by percent of total)

County	Gas Miles	Liquid Miles	% of Total
Reno	539	672	4.9%
McPherson	288	727	4.1%
Butler	294	505	3.2%
Rice	396	345	3.0%
Sedgwick	341	393	3.0%
Kiowa	443	139	2.3%
Clark	373	173	2.2%
Ford	491	35	2.1%
Meade	399	120	2.1%
Miami	309	217	2.1%
Washington	341	176	2.1%
Harvey	203	270	1.9%
Cowley	205	249	1.8%
Kingman	248	208	1.8%
Montgomery	119	319	1.8%
Pratt	298	159	1.8%
Franklin	380	33	1.6%
Seward	227	176	1.6%
Barton	290	86	1.5%
Johnson	255	115	1.5%
Stafford	264	113	1.5%
Ottawa	213	139	1.4%
Coffey	249	74	1.3%
Ellsworth	221	103	1.3%
Allen	95	178	1.1%
Dickinson	199	90	1.1%
Greenwood	199	87	1.1%
Lyon	188	84	1.1%
Marion	226	48	1.1%
Chase	209	36	1.0%
Lincoln	252	14	1.0%
Sumner	110	144	1.0%
Clay	92	134	0.9%
Cloud	160	78	0.9%
Edwards	209	19	0.9%
Saline	50	183	0.9%
Scott	166	53	0.9%
Wyandotte	71	158	0.9%
Anderson	126	77	0.8%

County	Gas Miles	Liquid Miles	% of Total
Barber	130	82	0.8%
Brown	145	69	0.8%
Grant	140	55	0.8%
Leavenworth	115	95	0.8%
Phillips	139	66	0.8%
Chautauqua	70	118	0.7%
Finney	139	40	0.7%
Harper	57	132	0.7%
Haskell	108	69	0.7%
Pawnee	132	38	0.7%
Rooks	147	41	0.7%
Comanche	79	74	0.6%
Marshall	95	62	0.6%
Rush	132	30	0.6%
Shawnee	60	88	0.6%
Trego	123	31	0.6%
Wilson	61	86	0.6%
Atchison	52	81	0.5%
Cherokee	102	31	0.5%
Douglas	88	48	0.5%
Ellis	111	31	0.5%
Gove	90	36	0.5%
Gray	105	23	0.5%
Jefferson	77	64	0.5%
Kearny	126	11	0.5%
Linn	0	130	0.5%
Morton	117	25	0.5%
Osage	86	39	0.5%
Pottawatomie	129	2	0.5%
Republic	84	49	0.5%
Stevens	102	27	0.5%
Cheyenne	101	0	0.4%
Geary	93	25	0.4%
Hamilton	100	0	0.4%
Lane	59	49	0.4%
Logan	76	37	0.4%
Nemaha	79	40	0.4%
Neosho	19	88	0.4%
Rawlins	98	0	0.4%
Thomas	106	11	0.4%
Wabaunsee	24	87	0.4%
Doniphan	23	62	0.3%
Greeley	75	0	0.3%
Hodgeman	69	3	0.3%
Jackson	43	47	0.3%
Labette	78	2	0.3%
Morris	25	63	0.3%
Ness	21	71	0.3%

County	Gas Miles	Liquid Miles	% of Total
Riley	56	23	0.3%
Russell	48	41	0.3%
Sherman	54	36	0.3%
Crawford	21	36	0.2%
Decatur	60	0	0.2%
Elk	63	0	0.2%
Graham	61	0	0.2%
Jewell	67	0	0.2%
Mitchell	55	0	0.2%
Norton	62	0	0.2%
Osborne	47	14	0.2%
Sheridan	62	0	0.2%
Smith	35	15	0.2%
Stanton	57	0	0.2%
Wallace	34	33	0.2%
Wichita	51	4	0.2%
Bourbon	28	3	0.1%
Woodson	2	37	0.1%
Totals	**14,831**	**9,538**	**100%**

Source: http://primis.phmsa.dot.gov/comm/reports/safety/KS_detail1.html?nocache=4906#_OuterPanel_tab_5

Figure 3.42. Gas Lines

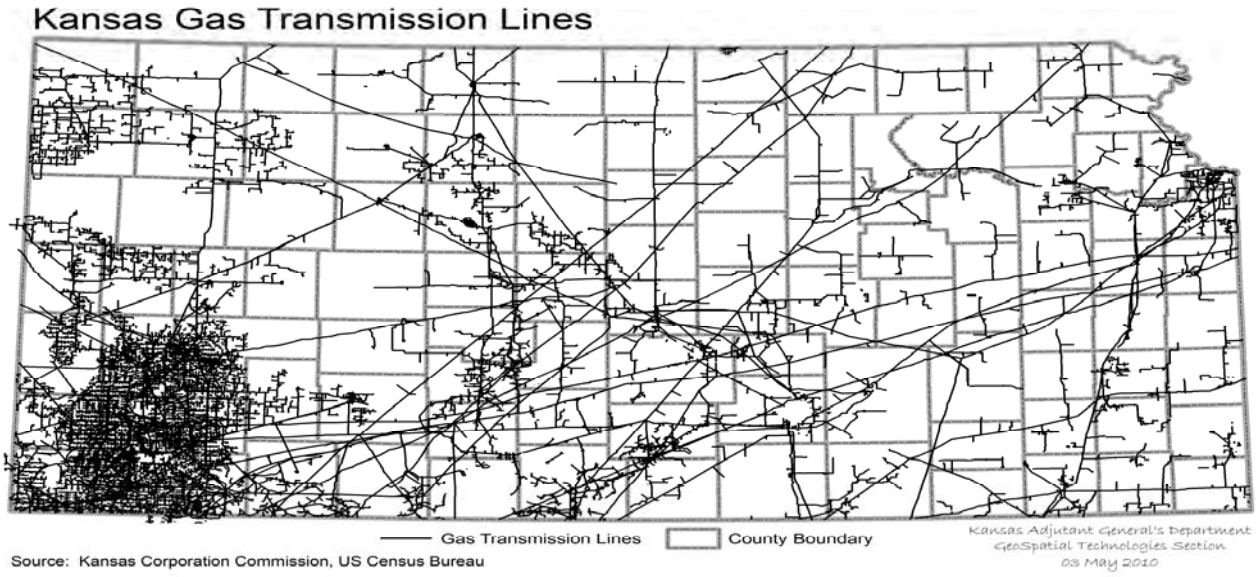
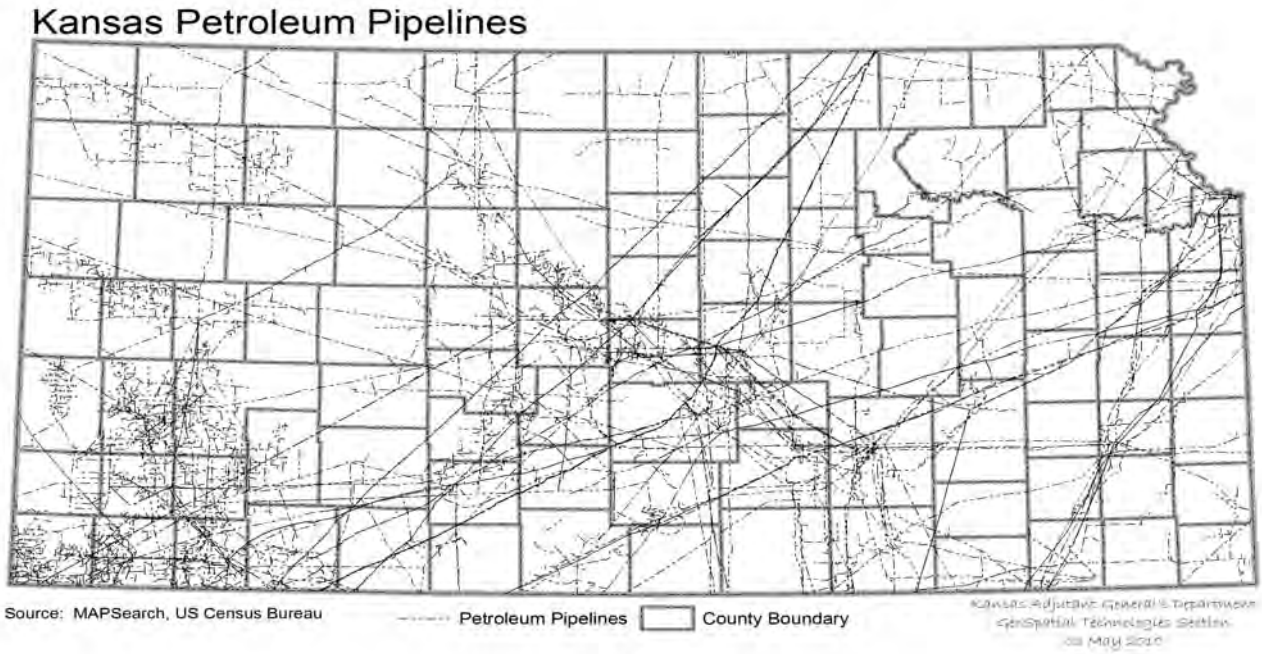


Figure 3.43. Petroleum Lines



Fixed Facility

In 2009, there were 11,036 Kansas facilities that reported housing hazardous chemicals. These facilities are illustrated by county in Figure 3.44.

Figure 3.44. Kansas Facilities Housing Hazardous Chemicals, 2009

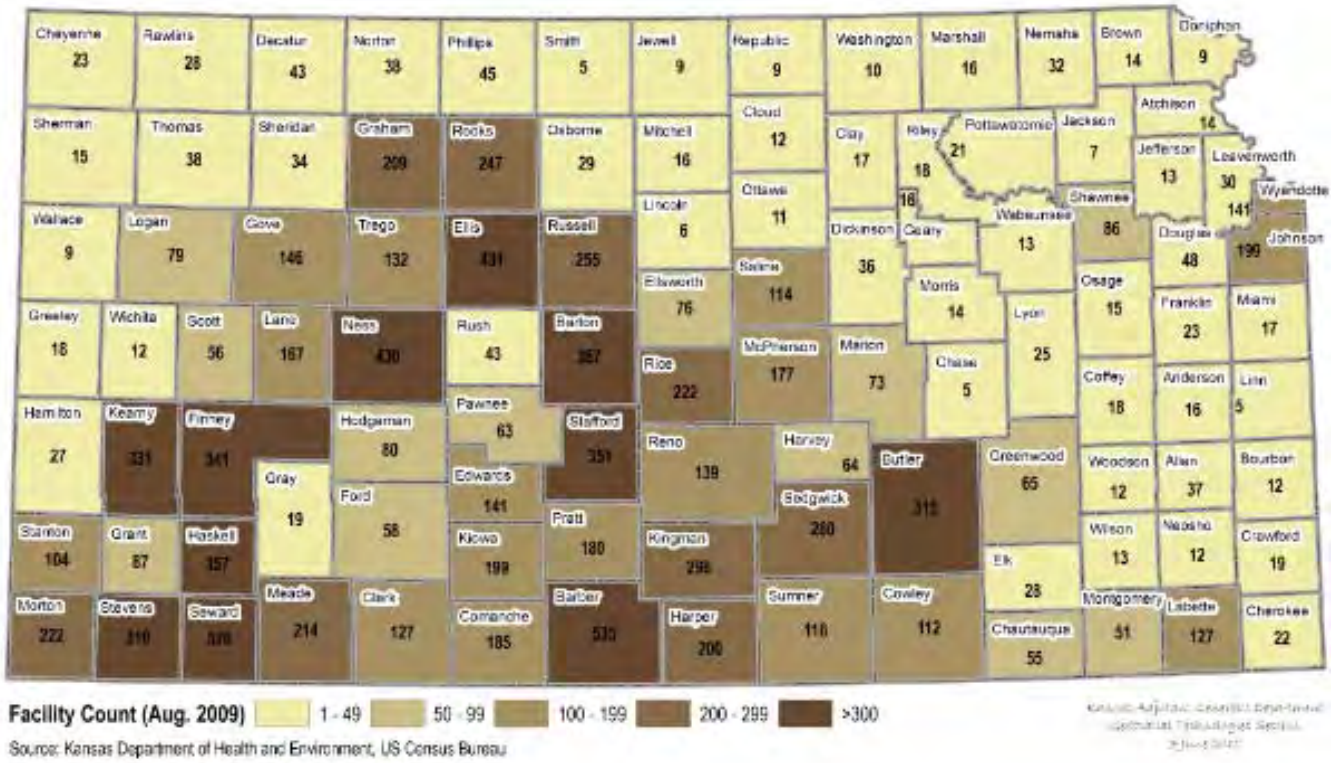
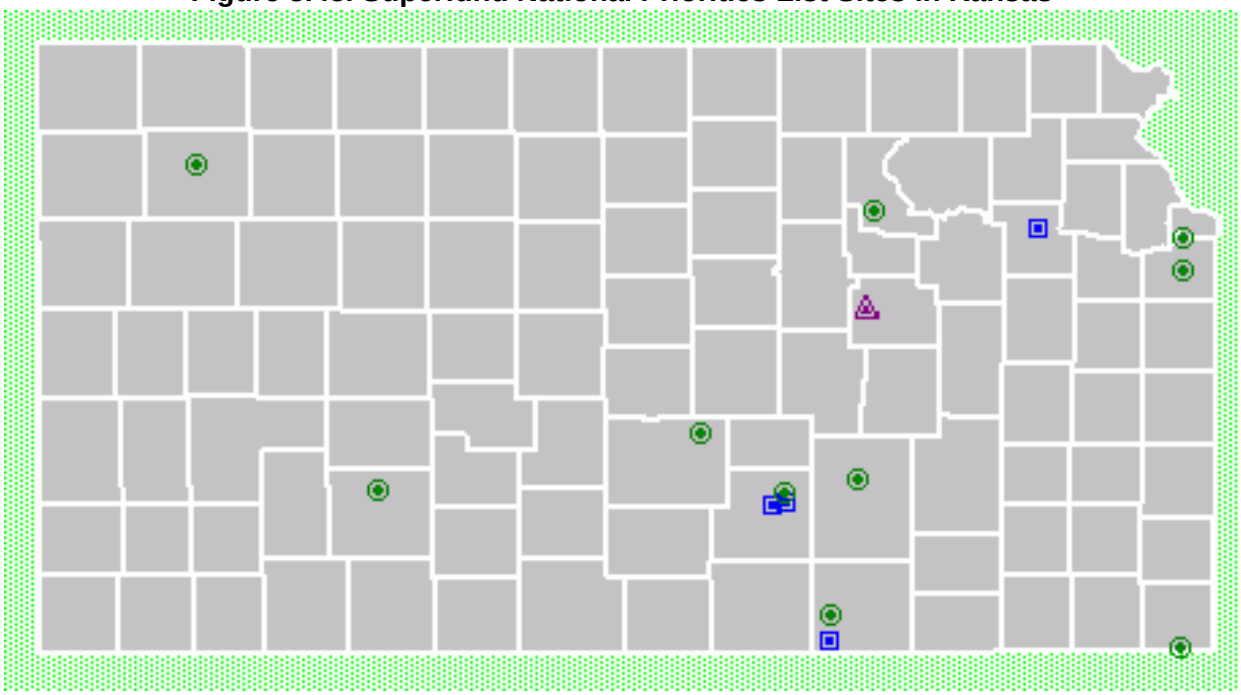


Figure 3.45 shows U.S. Environmental Protection Agency Superfund sites in Kansas. A Superfund site is an uncontrolled or abandoned place where hazardous waste is located, which may affect local ecosystems or people. Ten Kansas sites are currently on the Superfund National Priorities List. These sites are located in Butler, Cherokee, Cowley, Ford, Johnson (2), Reno, Riley/Geary, Sedgwick, and Thomas Counties. An eleventh proposed site is in Morris County.

Figure 3.45. Superfund National Priorities List Sites in Kansas



Map Key: Proposed: 1 Final: 10 Deleted: 5

Source: U.S. Environmental Protection Agency, www.epa.gov/superfund/sites/npl/ks.htm

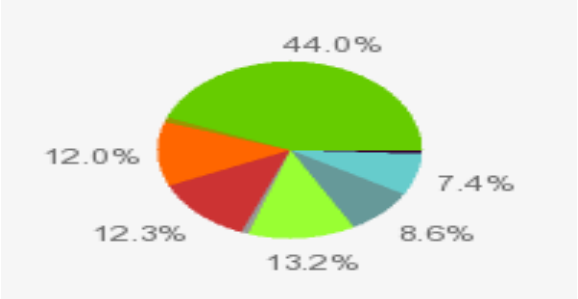
Previous Occurrences

When viewed statewide, hazardous materials accidents are frequent events. Statistics from the National Response Center, which serves as the sole national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the environment anywhere in the United States and its territories, indicate that between 1990 and 2007, over 7,000 incidents were reported in Kansas. This is an average of 412 reported HAZMAT events per year. Of the incidents, 59% were fixed, 13% were pipeline, 10% were railroad, and 8% were mobile (transportation on land).

The most recent HAZMAT incident data available for the Kansas Hazard Mitigation Plan Update is from the year 2008. In 2008, 325 HAZMAT incidences were reported. Of the incidents, 44% were fixed, 12% were pipeline, 9% were railroad, and 13.% were mobile (transportation on land).

HAZMAT EVENT	27 Year Average	Year 2008 (Latest Available Data)	Change
Fixed	59 %	44%	-15%
Pipeline	13%	12%	-1%
Railroad	10%	9%	-1%
Mobile (Transportation and Land)	8%	13%	+5%

Figure 3.46. Reports of Hazardous Materials Incidents, 2008



2008 Incident Type

	Type of incident	Number of incidents
	Aircraft accident	3
	Continuous release	2
	Fixed site (e.g. incident at a building)	143
	Wheeled vehicle (car or truck) accident	43
	Pipeline incident	40
	Drilling platform incident	0
	Railroad incident	28
	Railroad non-release incident	24
	Storage tank incident	39
	Unknown sheen on water	0
	Water vessel (ship or boat) accident	3
	Unknown	0
	Left Blank	0

Summary

Reporting Year: 2008
Total number of incidents: **325**
Total number of reported fatalities: **26**
Total number of reported hospitalizations: **15**
Total number of reported injuries: **17**
Total number of people evacuated: **651**
Total reported property damage: **$18,185,663**

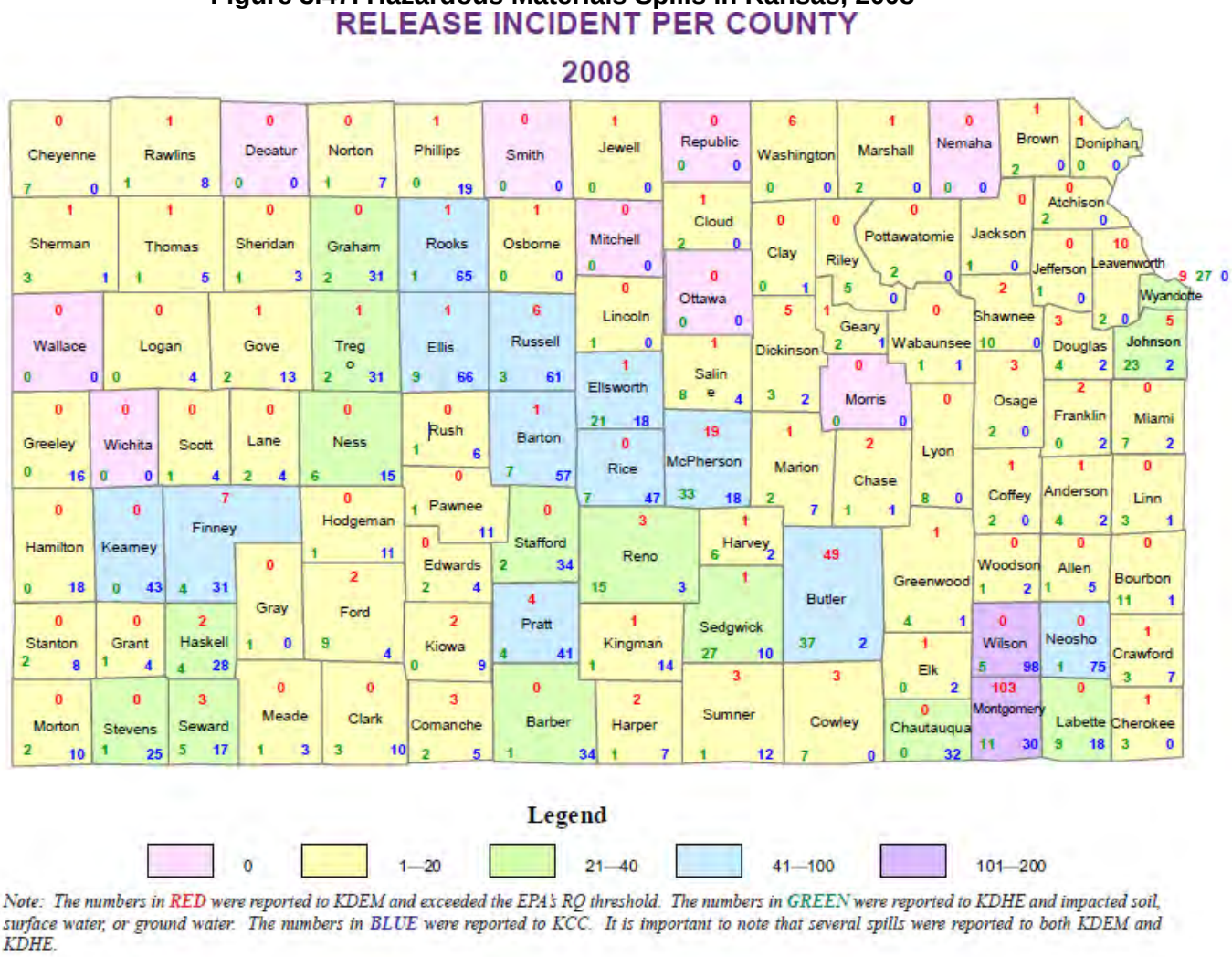
This data is the most current available from RTKnet.org

Most of the episodes are small, with relatively little safety or environmental consequences. Some recent hazardous materials events have been noteworthy.

In 2008, there were a total of 325 hazardous material spills or releases in Kansas reported to the Right-to-Know network, which was an improvement from 2007. Forty-four percent of the

spills occurred at fixed facilities, 12.3% were from pipelines, and 13.2% were related to transportation incidents.

Figure 3.47. Hazardous Materials Spills in Kansas, 2008



Source: Kansas Commission on Emergency Planning and Response "Managing the Risk" 2009 Annual Report, http://www.kansas.gov/kdem/EMSWeb/pdf/library/2009%20Managing%20the%20Risk.pdf

For 2008, the top five commodities reported to KDEM were sulfur dioxide, diesel fuel, fuels/crude oil, anhydrous ammonia, and hydrogen sulfide. In 2008, KDEM received 287 notifications that exceeded the RQ for the chemical. This is only one more spill than 2007 (286). KDHE received 423 notifications, which is down 51% from 2007. In 2007, the number of releases KDHE investigated was unusually high. There were 259 transformer oil releases, which was a direct result of the 2007 winter storms downing power poles. The counties with the most spills or releases reported in 2008 were: Montgomery (144), Wilson (103), Butler (88), Ellis and Neosho (76), McPherson and Russell (70). The numeric breakdown of the 423 spills is shown in Table 3.54.

Table 3.55. Materials Spilled in Spills Investigated by KDHE in 2008 (ranked by occurrence)

Material Spilled*	Number of Incidents
Electrical Insulating Oil / Mineral Oil	86
Diesel / Fuel Oil / Heating Oil	70
Brine / Salt Water	52
Crude Oil	40
Gasoline	23
Hydraulic Oil / Fluid	17
Contaminated Water	12
Lubrication Oil	10
Liquid Fertilizer	10
Ammonia	10
PCB Fluids	7
Natural Gas	6
Motor Oil	6
Naptha / Napthalene	4
Mercury	3
Jet Fuel	2
Ethanol	2
Dry Grain Fertilizer	2
Calcium Oxide	2

Source: Kansas Commission on Emergency Planning and Response "Managing the Risk" 2009 Annual Report, http://www.kansas.gov/kdem/EMSWeb/pdf/library/2009%20Managing%20the%20Risk.pdf
*Other reports are single events.

Notable Hazardous Materials Incidents

- In recent years, a number of hazardous materials incidents involving illegal drug manufacturing occurred in the state.
- June 15, 2010 - A Union Pacific train, with 66 cars and two locomotives, was stuck for hours on a sagging bridge over the Chikaskia River on Tuesday, June 15, 2010 in southern Sumner County just a few miles northeast of Caldwell and about 13 miles southwest of Wellington, Kansas. Caldwell is in Sumner County, Kansas in the southern central part of the state near the Oklahoma border about 28 miles southwest of Wellington, about 248 miles southwest of Kansas City, about 60 miles southwest of Wichita and about 193 miles southwest of Topeka. The southbound train was carrying hazardous materials. The train sat for hours while the community kept its eye on the water supply. There was some concern because the water supply in the area comes from an aquifer that is fed partially by the river. There were concerns over possible contamination from hazardous materials. The engine carried thousands of gallons of diesel fuel and one of the cars was carrying anhydrous ammonia. The initial concern was that the trestle would collapse and drop the train into the Chikaskia River. It could have been a catastrophe, considering that there were hazardous materials involved. In the end, the river was out of danger and the train was safely removed from the bridge, but it was a tense day. It was not a sight one would see every day. The train was stopped on a trestle that looked ready to collapse.
- March 21, 2010 - Riley County, Kansas Fire Department responded to a report of a HAZMAT Spill located on the K-16 Bridge, which traverses Tuttle Creek Reservoir. The mile long bridge, known as the Randolph Bridge, is the longest bridge in the state of Kansas and is located approximately two miles east of Randolph, Kansas. The bridge is currently closed

for rehabilitation. It was initially reported that there was a diesel fuel spill. First arriving, companies found that midway across the bridge a 30-ton construction crane had fallen 83 feet from the bridge deck into the lake. It was further reported that the crane operator and a ground guide had escaped prior to the machine falling from the bridge and that there were no injuries.

- July 17, 2007 – On the morning of July 17, 2007, hundreds of people were evacuated from the town of Valley Center near Wichita, Kansas after an explosion and subsequent fire at a Barton Solvent plant. Authorities determined that 36 storage tanks containing approximately 660,000 pounds of chemicals, including hydrocarbons, ketones and alcohol, went up in smoke. The fire was so intense that firefighters could do little to extinguish the flames; instead they mainly kept the blaze from spreading to nearby buildings. The fire marshal for the Wichita Fire Department said, "The plume looks like it's going up into the air and dissipating." Miraculously, no one at the plant or its surroundings was injured in the explosion, although 10 people were admitted to a Wichita hospital as a precautionary measure. Barton employs about two dozen people and half its employees were at work at the time of the explosion.
- June 26-30, 2007—In Montgomery County, heavy rains caused the Verdigris River to overflow its banks, top protective levees, and flood the town of Coffeyville. As floodwaters rose, officials at the Coffeyville Resources refinery and nitrogen fertilizer plant ordered the facilities shut down and evacuated. Despite their efforts to secure the refinery, an estimated 71,000 gallons of crude oil and a small amount of oil from the refinery's sewer system were swept away by flood waters. During the plant shutdown, the pump system from the east tank storage facility was shut down, but oil continued to flow because of an elevation difference, causing the main oil storage tank on the refinery to overflow. The U.S. Environmental Protection Agency conducted monitoring for the presence of volatile organic compounds in flood waters in Coffeyville and downstream, but indicated the presence of these compounds was not at a "level of concern." Contamination and health issues led local officials to prevent many people from returning to their flood-damaged homes before it was determined safe.
- 2003—A train derailment in 2003 in Barber County required the precautionary evacuation of people within a one-mile area.
- 2002—In downtown Sterling, a fire broke out in a business producing chemicals mostly used in oil fields.
- August 30, 2001—A train carrying hazardous materials derailed near Mulvane requiring the evacuation of more than 100 people.
- January 2001—An apparent leak in the baggy gas storage field resulted in explosions that killed two people and destroyed several buildings in Hutchinson. This event continued for weeks.
- 2000—There was a train derailment near Arlington and an explosion and fire at Farmland Industries Lawrence fertilizer plant.
- 1999—Six people died and 54 were injured from hazardous materials releases in Kansas.
- June 8, 1998—A massive explosion took place at the DeBruce Grain Company in Haysville. Seven people died and eleven were injured. Harvey and Sedgwick Counties received federal emergency declarations (FEMA-3126-EM).
- 1998—A train carrying hazardous chemicals derailed and caught fire sending a cloud into the air and forcing evacuation of Hazelton.

Transportation

The Hazardous Materials Incident Report Subsystem (HMIRS) of the Pipeline and Hazardous Materials Safety Administration (PHMSA) Hazardous Materials Information System was established in 1971 to fulfill the requirements of the federal hazardous materials transportation law. Unintentional releases of hazardous materials or the discharge of any quantity of hazardous waste must be reported. The law defines hazardous material as "a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has designated as hazardous. The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (see 49 CFR 172.101)."

According to the U.S. Department of Transportation's (DOT) Hazardous Materials Information System, Kansas experienced 8,343 transportation incidents involving hazardous materials between 1971 and 2008. The total cost of damage associated with these incidents (1971 – 2008) was approximately $36.6 million. This suggests that Kansas experiences 241 transportation incidents involving hazardous materials and $886,000 in related damage each year. Among these incidents there were 45 deaths and 305 injuries. In total, 10,458 people were evacuated. For 2007 – 2008 the Right-to-Know network lists 147 transportation incidents for the State of Kansas, with over $23.2 million dollars in reported damages.

Pipeline

Reports from the DOT's Office of Pipeline Safety provide detail and incident history for the pipeline systems in the State of Kansas between 2007 and 2009. Significant incidents are those incidents reported by pipeline operators with any of the following conditions met: 1) fatality or injury requiring in-patient hospitalization; 2) $50,000 or more in total costs, measured in 1984 dollars; 3) highly volatile liquid releases of five barrels or more or other liquid releases of 50 barrels or more; 4) liquid releases resulting in an unintentional fire or explosion. According to these reports, there were 32 pipeline incidents that caused no deaths, 7 injuries, and $27.9 million in damages over the three-year period (2007-2009). Thus, on average, Kansas experiences 10 incidents, 2 injuries, and $9 million in damage each year.

Table 3.56. Pipeline Events 2007 - 2009

Date	Location	Operator	Cause	Fat.	Injs.	Prop. Dmg.	Gross BarrelLoss	Net Barrel Loss
02/05/2007	HUTCHINSON	SOUTHERN STAR CENTRAL GAS PIPELINE, INC	MAT'L/WELD/EQUIP FAILURE	0	0	$6,693,627	N/A	N/A
02/16/2007	HLSTEAD	PANHANDLE ENERGY	ALL OTHER CAUSES	0	0	$221,395	N/A	N/A
03/06/2007	EL DORADO	ENTERPRISE PRODUCTS OPERATING LLC	CORROSION	0	0	$32,068	5	5
03/06/2007	LYONS	AQUILA NETWORKS	CORROSION	0	2	$30,270	N/A	N/A
03/26/2007	MULLINVILLE	NORTHERN NATURAL GAS COMPANY	MAT'L/WELD/EQUIP FAILURE	0	0	$128,434	N/A	N/A
05/04/2007		KANSAS GAS SERVICE	NATURAL FORCE DAMAGE	0	0	$1,702,565	N/A	N/A
06/18/2007		KANSAS GAS SERVICE	EXCAVATION DAMAGE	0	1	$18,211	N/A	N/A
06/18/2007	HUTCHINSON	SOUTHERN STAR CENTRAL GAS PIPELINE INC.	MAT'L/WELD/EQUIP FAILURE	0	0	$272,745	N/A	N/A
08/18/2007	MCLOUTH	SOUTHERN STAR CENTRAL GAS PIPELINE	CORROSION	0	0	$1,662,071	N/A	N/A
09/11/2007	ENGLEWOOD	ENTERPRISE PRODUCTS OPERATING, L.L.C.	MAT'L/WELD/EQUIP FAILURE	0	0	$1,553,390	6,000	6,000
11/21/2007	HAVEN	PANHANDLE EASTERN PIPELINE CO	CORROSION	0	0	$613,556	N/A	N/A
01/27/2008	COLDWATER	ENTERPRISE PRODUCTS OPERATING LLC	MAT'L/WELD/EQUIP FAILURE	0	0	$294,979	10	10
03/14/2008	GOESSEL	SOUTHERN STAR CENTRAL GAS PIPELINE,	OTHER OUTSIDE FORCE	0	0	$217,980	N/A	N/A

		INC	DAMAGE					
04/06/2008	EL DORADO	ENBRIDGE PIPELINES (OZARK) L.L.C.	CORROSION	0	0	$204,137	550	N/A
05/24/2008	CUNNINGHAM	NORTHERN NATURAL GAS CO	NATURAL FORCE DAMAGE	0	0	$173,517	N/A	N/A
05/30/2008	LANGDON	ENTERPRISE PRODUCTS OPERATING LLC	MAT'L/WELD/EQUIP FAILURE	0	0	$229,787	2	2
06/03/2008	KANSAS CITY	MAGELLAN PIPELINE COMPANY, LP	NATURAL FORCE DAMAGE	0	0	$9,968,200	9	9
08/07/2008	TOPEKA	KANSAS GAS SERVICE	OTHER OUTSIDE FORCE DAMAGE	0	0	$142,343	N/A	N/A
08/15/2008	WELDA	SOUTHERN STAR CENTRAL GAS PIPELINE, INC	CORROSION	0	0	$375,087	N/A	N/A
08/26/2008	INDEPENDENCE	BP PIPELINE (NORTH AMERICA) INC.	EXCAVATION DAMAGE	0	0	$179,641	80	N/A
10/03/2008	EL DORADO	ENTERPRISE PRODUCTS OPERATING LLC	EXCAVATION DAMAGE	0	0	$725,802	531	210
12/12/2008	MCPHERSON	MID-CONTINENT FRACTIONATION AND STORAGE, L.L.C.	CORROSION	0	0	$8,880	5	5
01/25/2009	MAPLE CITY	OSAGE PIPE LINE COMPANY, LLC	MAT'L/WELD/EQUIP FAILURE	0	0	$1,117,999	1,174	94
04/07/2009	CHANUTE	SOUTHERN STAR CENTRAL GAS PIPELINE, INC	OTHER OUTSIDE FORCE DAMAGE	0	1	$110,863	N/A	N/A
06/09/2009	PAOLA	CONOCOPHILLIPS	MAT'L/WELD/EQUIP FAILURE	0	0	$202,697	1,718	1,718
06/22/2009	CODELL	JAYHAWK PIPELINE LLC	CORROSION	0	0	$21,700	1,000	3
07/08/2009	CODELL	JAYHAWK PIPELINE LLC	ALL OTHER CAUSES	0	0	$12,500	150	28
07/08/2009	ANTHONY	ATMOS ENERGY CORPORATION - COLORADO/KANSAS	OTHER OUTSIDE FORCE DAMAGE	0	3	$601,440	N/A	N/A
08/20/2009	YODER	SEMGROUP LP	CORROSION	0	0	$134,000	88	48
08/20/2009	CONWAY	MAGELLAN AMMONIA PIPELINE, L.P.	MAT'L/WELD/EQUIP FAILURE	0	0	$105,155	2	2
11/22/2009	MCPHERSON	ENTERPRISE PRODUCTS OPERATING LLC	ALL OTHER CAUSES	0	0	$98,660	10	10
11/30/2009	MCPHERSON	ENTERPRISE PRODUCTS OPERATING LLC	ALL OTHER CAUSES	0	0	$124,300	10	10
				0	7	$27,977,999.00	5,339	8,154

Fixed Facility

Begun in 1988, the Toxics Release Inventory (TRI) contains information on releases of nearly 650 chemicals and chemical categories from industries including manufacturing, metal and coal mining, electric utilities, and commercial hazardous waste treatment, among others. The TRI is a federal program established by the U.S. Environmental Protection Agency (EPA), but the Kansas Department of Health and Environment is required to maintain the inventory. Facilities are required to file reports of their disposal or other environmental releases as well as other waste management quantities of regulated chemicals if they manufacture, process, or otherwise use more than the established threshold quantities of these chemicals.

According to the TRI, 293 facilities released or disposed of 24,628,245 (a decrease from 29,646,258 in 2005) pounds of 144 types of hazardous materials in Kansas in 2008. Table 3.57 ranks chemical releases by county for 2008. Tables 3.58 and 3.59 show the top 10 releasing facilities and the top 10 chemicals released in 2008.

Note: The data does not reflect whether (or to what degree) the public has been exposed to any of the TRI chemicals. Both the toxicity of a chemical and exposure considerations should be taken into account when examining the data. Some high-volume releases of less toxic chemicals may appear to be a more serious problem than lower volume releases of highly toxic chemicals, when just the opposite may be true.

The TRI does not cover all toxic chemicals that have the potential to adversely affect human health or the environment. Facilities that do not meet the reporting threshold levels are not required to report. The data does not include emissions from mobile sources nor releases of pesticides, volatile organic compounds, or fertilizers from many nonindustrial sources. This information is used to demonstrate an average number of releases.

Table 3.57. Chemical Releases* by County, 2008 (all figures are in pounds)

County	Total On-Site Disposal or Other Releases	Total Off-Site Disposal or Other Releases	Total On- and Off-Site Disposal or Other Releases
Ford	3,639,789	1,000	3,640,789
Linn	2,982,082	10	2,982,092
Wyandotte	2,041,379	843,678	2,885,057
Montgomery	696,917	1,433,259	2,130,176
Pottawatomie	2,031,439	8,788	2,040,227
Sedgwick	1,643,856	228,167	1,872,023
Shawnee	1,490,703	33,939	1,524,642
Finney	1,392,480	131,627	1,524,107
Douglas	1,454,851	2,457	1,457,308
Cherokee	293,116	789,402	1,082,518
Butler	371,624	176,210	547,834
McPherson	284,558	111,237	395,795
Atchison	187,029	205,773	392,802
Wilson	363,402	6,107	369,509
Lyon	317,611	6,961	324,572
Rush	210,760	0	210,760
Geary	167,575	0	167,575
Saline	66,143	80,570	146,713
Johnson	93,203	27,344	120,547
Labette	101,227	0	101,227
Neosho	99,327	85	99,412
Allen	35,587	57,349	92,936
Barton	70,334	18,853	89,187
Seward	85,204	1,077	86,281
Sherman	67,229	0	67,229
Harvey	58,366	504	58,870
Reno	52,628	249	52,877
Ottawa	49,840	0	49,840
Bourbon	29,888	8,182	38,070
Anderson	33,650	0	33,650
Phillips	30,607	0	30,607
Cowley	26,910	1,061	27,971
Rice	12,087	0	12,087
Gove	11,685	0	11,685
Russell	11,361	0	11,361
Ellis	1,081	9,206	10,287
Grant	8,516	7	8,523
Osborne	8,373	0	8,373
Doniphan	7,076	0	7,076
Smith	5,471	0	5,471
Dickinson	4,747	0	4,747
Marshall	2,020	0	2,020
Leavenworth	34	1,000	1,034
Cloud	750	0	750
Ellsworth	0	20	20

County	Total On-Site Disposal or Other Releases	Total Off-Site Disposal or Other Releases	Total On- and Off-Site Disposal or Other Releases
Kingman	16	0	16
Crawford	13	0	13
Barber	1	5	6
Total	**20,542,545**	**4,085,700**	**24,628,245**

Source: U.S. Environmental Protection Agency, Toxics Release Inventory, www.epa.gov/tri/
* Includes releases to land, air, and water

Table 3.58. Top 10 Kansas Facilities with Greatest Total Releases,* 2008 (all figures are in pounds)

Facility	County	Total On-site Disposal or Other Releases	Total Off-site Disposal or Other Releases	Total On- and Off-site Disposal or Other Releases
Great Plains Energy La Cygne Generating Station	Linn	2,982,082	10	2,982,092
Koch Nitrogen Co. LLC	Ford	2,547,027	0	2,547,027
Jeffrey Energy Center	Pottawatomie	1,901,462	0	1,901,462
Coffeyville Resources Nitrogen Fertilizers Llc	Montgomery	308,435	1,398,663	1,707,098
Lawrence Energy Center	Douglas	1,443,161	0	1,443,161
Innovia Films Inc	Shawnee	1,280,968	0	1,280,968
Holcomb Unit 1	Finney	1,230,060	0	1,230,060
Cargill Meat Solutions	Ford	1,064,118	0	1,064,118
Jayhawk Fine Chemical Corp	Cherokee	9,864	789,397	799,261
Spirit Aerosystems Inc.	Sedgwick	597,571	163,798	761,369

Source: U.S. Environmental Protection Agency, Toxic Resources Inventory, www.epa.gov/tri/
* Includes releases to land, air, and water

Table 3.59. Top 10 Chemicals Reported Released* in Kansas, 2008 (all figures are in pounds)

Chemical	Total On-site Disposal or Other Releases	Total Off-site Disposal or Other Releases	Total On and Off-site Disposal or Other Releases
Barium compounds	5,901,968	0	5,901,968
Ammonia	2,926,217	357,420	3,283,637
Nitrate compounds	1,987,792	573,657	2,561,449
Carbon disulfide	1,120,531	0	1,120,531
Vanadium (except when contained in an alloy)	19,599	1,032,195	1,051,794
Manganese	614,836	177,949	792,785
Styrene	771,508	177	771,685
Sulfuric acid (1994 and after "acid aerosols" only)	746,917	0	746,917
Barium	182,857	542,243	725,100
Chromium compounds(except chromite ore mined in the transvaal region)	103,914	566,097	670,011

Probability
A hazardous materials event is probable somewhere within Kansas every year. Therefore, this hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Transportation
According to the U.S. Department of Transportation's (DOT) Hazardous Materials Information System, Kansas experienced 8,343 transportation incidents involving hazardous materials between 1971 and 2008. The total cost of damage associated with these incidents (1971 – 2008) was approximately $36.6 million. This suggests that Kansas experiences 241 transportation incidents involving hazardous materials and $886,000 in related damage each year.

Pipeline
According to the U.S. Department of Transportation's Office of Pipeline Safety, there were 32 significant pipeline incidents in Kansas between 2007 and 2009 (3 years). Based on this information, the probability that at least one pipeline incident will occur in Kansas in any given year is 100%. The estimated annualized property loss is $9.3 million.

Fixed Facility
According to the U.S. Environmental Protection Agency's Toxic Resource Inventory, 24,628,245 pounds of hazardous materials were disposed of or released in Kansas in 2008. Based on this information, there is a 100% probability that a fixed facility will dispose of or release a hazardous material in Kansas each year.

Probability

Based on historical records, multiple HAZMAT events occur every year in the State of Kansas. This hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	HAZMAT Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years.		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

According to the Kansas Division of Emergency Management, there are 40 "critical" sites in Kansas. They are deemed so because of the severity of the chemicals, the quantity of chemicals, and the amount of population affected in a worst-case scenario. These facilities are listed below in order of criticality. Sedgwick County has the greatest number of these facilities with six (numbers 2, 6, 12, 24, 25, and 36) followed by Wyandotte County with five (numbers 3, 4, 10, 14, and 38). Ford, Lyon, Montgomery, and Saline each have three. Information about these facilities in this plan is limited because of security and liability issues. For the 2010 plan update, the following list remained unchanged:

1. Coffey County—Energy Plant
2. Sedgwick County—Chemical Plant
3. Wyandotte County—Chemical Plant
4. Wyandotte County—Specialty Gas
5. Shawnee County—Water Treatment
6. Sedgwick County—Water Treatment
7. Leavenworth County—Water Treatment
8. Ford County—Nitrogen Plant
9. Saline County—Water Treatment
10. Wyandotte County—Soap Plant
11. Butler County—Refinery
12. Sedgwick County—Ethanol Plant
13. Ford County—Beef Packing
14. Wyandotte County—Water Processing
15. Lyon County—Beef Packing
16. Ford County—Meat Processing
17. Saline County—Food Processing
18. Cherokee County—Chemical Manufacturing
19. McPherson County—Refinery
20. Finney County—Fertilizer Plant
21. Lyon County—Feed/Elevator/Fertilizer
22. Johnson County—Food Distribution
23. Seward County—Water Treatment
24. Sedgwick County—Chemical Distribution
25. Sedgwick County—Meat Processing
26. Barton County—Fertilizer Sales
27. Lyon County—Water Treatment
28. Saline County—Processing and Storage of Fertilizers
29. McPherson County—Chemical Production and Distribution
30. Ellis County—Water Treatment
31. Montgomery County—Chemical Production and Distribution
32. Shawnee County—Food Manufacturing
33. Crawford County—Water Treatment
34. Cowley County—Beef Packing
35. Montgomery County—Refinery
36. Sedgwick County—Produces Dairy Products
37. Johnson County—Food Manufacturing
38. Wyandotte County—Refrigerated Warehouse
39. Montgomery County—Nitrogen Fertilizer Plant

40. Reno County—Food Processing

For the purposes of analyzing the vulnerability of jurisdictions, the state also relied on the information from the National Response Center. Table 3.60 shows all of the incidents reported by the NRC from 2000-2009 in the U.S.

Table 3.60. National Hazardous Materials Incidents by Type, 2000–2009

Incident Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fixed	11,813	12,441	11,917	11,975	12,975	13,017	13,621	11,913	10,909	10,123
Unknown Sheen	4,016	4,147	3,426	3,733	3,411	3,934	3,797	4,199	4,278	4,254
Vessel	3,945	4,378	3,919	3,962	4,385	4,611	4,767	4,931	5,030	4,597
Mobile	3,597	3,216	2,942	2,947	3,192	3,215	3,267	3,297	3,238	2,854
Pipeline	1,618	1,841	1,621	1,643	1,574	1,896	1,839	1,580	1,379	1,275
Platform	1,428	1,355	1,233	1,344	1,198	1,395	1,606	1,407	1,362	1,761
Storage Tank	1,379	3,140	3,044	2,808	2,838	2,687	2,577	2,519	2,460	1,973
Railroad Non-Release	1,335	1,235	1,124	1,173	1,476	1,685	1,868	1,913	1,482	1,435
Railroad	1,332	1,241	1,200	1,074	1,276	1,532	1,451	1,390	1,649	1,306
Continuous	938	238	393	462	112	189	150	284	62	94
Aircraft	248	297	278	262	277	211	217	214	204	175
Drill/Exercise	669	789	908	743	1,073	1,223	1,578	1,584	1,829	2,039
Unknown	84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Terrorist Non-Release	33	42	180	105	125	119	117	43	0	0
TOTAL INCIDENTS	**32,435**	**34,360**	**32,185**	**32,231**	**33,912**	**35,714**	**36,855**	**35,274**	**33,882**	**31,886**

In terms of estimating potential losses the most significant loss potential with hazardous materials is the potential for deaths and injuries. As with all hazard events, special populations are particularly vulnerable to the impacts of a hazardous materials incident especially because of the inherent difficulties involved in evacuation. The state has inventoried special population's facilities (adult, child care, and health facilities; state prisons; and schools) 1/2, 1, and 2 miles from chemical facilities. Table 3.61 shows the percentage of each type of these facilities each county has within 1/2 mile of a chemical facility.

Table 3.61. 2010 Special Population Facilities near Chemical Facilities

	Percentage within 1/2 mile of Chemical Facility					
County	Health Facilities	Colleges	Educational Facilities	Aging Facilities	Child Care	Correctional Institutions
Allen	100.0%	0.0%	84.6%	57.1%	66.2%	100.0%
Anderson	100.0%	100.0%	66.7%	100.0%	28.6%	0.0%
Atchison	14.3%	0.0%	33.3%	20.0%	42.6%	50.0%
Barber	100.0%	0.0%	80.0%	100.0%	87.5%	100.0%
Barton	93.8%	0.0%	76.2%	55.6%	67.8%	100.0%
Bourbon	71.4%	0.0%	14.3%	0.0%	16.7%	100.0%
Brown	75.0%	0.0%	40.0%	66.7%	61.8%	100.0%
Butler	66.7%	0.0%	56.0%	27.3%	43.3%	33.3%
Chase	0.0%	0.0%	66.7%	100.0%	66.7%	100.0%
Chautauqua	80.0%	0.0%	80.0%	100.0%	60.0%	100.0%

Cherokee	71.4%	0.0%	31.6%	25.0%	39.5%	100.0%
Cheyenne	100.0%	0.0%	50.0%	100.0%	85.7%	100.0%
Clark	42.9%	0.0%	33.3%	100.0%	25.0%	0.0%
Clay	40.0%	0.0%	28.6%	33.3%	61.4%	100.0%
Cloud	71.4%	0.0%	22.2%	66.7%	76.0%	100.0%
Coffey	25.0%	0.0%	63.6%	0.0%	50.0%	100.0%
Comanche	100.0%	0.0%	66.7%	50.0%	50.0%	0.0%
Cowley	0.0%	50.0%	35.5%	33.3%	29.7%	66.7%
Crawford	50.0%	0.0%	71.4%	38.5%	31.4%	100.0%
Decatur	100.0%	0.0%	100.0%	50.0%	83.3%	100.0%
Dickinson	18.2%	0.0%	38.1%	66.7%	56.9%	100.0%
Doniphan	66.7%	0.0%	45.5%	0.0%	37.0%	100.0%
Douglas	46.7%	40.0%	29.3%	42.1%	26.3%	100.0%
Edwards	100.0%	0.0%	66.7%	0.0%	37.5%	100.0%
Elk	100.0%	0.0%	25.0%	0.0%	66.7%	100.0%
Ellis	46.2%	100.0%	68.4%	16.7%	53.1%	100.0%
Ellsworth	50.0%	0.0%	85.7%	66.7%	60.0%	50.0%
Finney	100.0%	0.0%	57.1%	66.7%	47.8%	100.0%
Ford	55.6%	0.0%	41.2%	33.3%	41.6%	100.0%
Franklin	0.0%	0.0%	25.0%	25.0%	30.6%	100.0%
Geary	0.0%	0.0%	36.4%	0.0%	33.8%	100.0%
Gove	100.0%	0.0%	28.6%	100.0%	27.3%	0.0%
Graham	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Grant	100.0%	0.0%	50.0%	100.0%	43.3%	100.0%
Gray	0.0%	0.0%	55.6%	50.0%	42.9%	0.0%
Greeley	100.0%	0.0%	0.0%	100.0%	80.0%	100.0%
Greenwood	100.0%	0.0%	37.5%	50.0%	57.1%	100.0%
Hamilton	100.0%	0.0%	50.0%	100.0%	42.9%	100.0%
Harper	100.0%	0.0%	100.0%	100.0%	84.0%	100.0%
Harvey	37.5%	50.0%	47.6%	50.0%	39.7%	100.0%
Haskell	25.0%	0.0%	66.7%	0.0%	57.1%	100.0%
Hodgeman	0.0%	0.0%	75.0%	100.0%	33.3%	100.0%
Jackson	25.0%	0.0%	30.0%	66.7%	19.0%	0.0%
Jefferson	16.7%	0.0%	38.9%	44.4%	26.1%	0.0%
Jewell	100.0%	0.0%	83.3%	100.0%	100.0%	100.0%
Johnson	64.4%	48.0%	29.9%	50.6%	33.3%	91.7%
Kearny	0.0%	0.0%	83.3%	0.0%	71.4%	100.0%
Kingman	66.7%	0.0%	77.8%	50.0%	57.6%	100.0%
Kiowa	100.0%	100.0%	100.0%	66.7%	62.5%	100.0%
Labette	69.2%	100.0%	25.0%	62.5%	37.8%	75.0%
Lane	100.0%	0.0%	100.0%	100.0%	60.0%	100.0%
Leavenworth	50.0%	100.0%	36.1%	0.0%	25.5%	100.0%
Lincoln	100.0%	0.0%	75.0%	50.0%	89.5%	100.0%
Linn	100.0%	0.0%	22.2%	0.0%	22.2%	0.0%
Logan	33.3%	0.0%	71.4%	100.0%	50.0%	100.0%
Lyon	50.0%	50.0%	30.8%	42.9%	39.3%	100.0%
McPherson	80.0%	66.7%	66.7%	76.5%	79.8%	100.0%
Marion	40.0%	100.0%	73.3%	42.9%	67.2%	100.0%
Marshall	77.8%	0.0%	69.2%	100.0%	57.1%	100.0%
Meade	87.5%	0.0%	100.0%	100.0%	100.0%	100.0%
Miami	0.0%	0.0%	20.0%	33.3%	33.7%	100.0%
Mitchell	100.0%	0.0%	63.6%	0.0%	67.7%	50.0%
Montgomery	85.7%	66.7%	75.0%	38.5%	55.1%	100.0%
Morris	0.0%	0.0%	20.0%	0.0%	37.5%	0.0%
Morton	0.0%	0.0%	33.3%	100.0%	80.0%	100.0%
Nemaha	77.8%	0.0%	71.4%	62.5%	73.3%	100.0%
Neosho	11.1%	0.0%	61.5%	42.9%	56.6%	100.0%
Ness	33.3%	0.0%	66.7%	50.0%	58.3%	0.0%
Norton	100.0%	0.0%	83.3%	25.0%	90.0%	50.0%
Osage	0.0%	0.0%	53.3%	28.6%	32.0%	0.0%
Osborne	66.7%	0.0%	100.0%	42.9%	50.0%	0.0%
Ottawa	100.0%	0.0%	71.4%	50.0%	66.7%	100.0%

Pawnee	66.7%	0.0%	54.5%	66.7%	45.5%	25.0%
Phillips	66.7%	0.0%	50.0%	0.0%	81.8%	100.0%
Pottawatomie	61.5%	100.0%	42.9%	66.7%	27.6%	100.0%
Pratt	14.3%	0.0%	36.4%	33.3%	46.2%	100.0%
Rawlins	66.7%	0.0%	100.0%	100.0%	77.8%	100.0%
Reno	42.9%	0.0%	37.5%	28.6%	23.1%	50.0%
Republic	100.0%	0.0%	85.7%	75.0%	93.8%	100.0%
Rice	60.0%	0.0%	92.9%	50.0%	74.3%	0.0%
Riley	57.1%	50.0%	38.1%	14.3%	26.7%	100.0%
Rooks	85.7%	0.0%	87.5%	100.0%	71.0%	50.0%
Rush	100.0%	0.0%	50.0%	100.0%	92.3%	0.0%
Russell	60.0%	0.0%	116.7%	40.0%	44.8%	100.0%
Saline	80.0%	50.0%	29.2%	54.5%	35.9%	100.0%
Scott	100.0%	0.0%	66.7%	100.0%	93.3%	100.0%
Sedgwick	46.5%	52.4%	34.6%	28.4%	26.6%	70.0%
Seward	50.0%	0.0%	56.3%	0.0%	46.5%	100.0%
Shawnee	64.3%	77.8%	28.1%	50.0%	23.2%	66.7%
Sheridan	0.0%	0.0%	66.7%	0.0%	54.5%	100.0%
Sherman	0.0%	0.0%	66.7%	50.0%	47.6%	100.0%
Smith	50.0%	0.0%	83.3%	83.3%	71.4%	100.0%
Stafford	50.0%	0.0%	33.3%	33.3%	18.8%	0.0%
Stanton	0.0%	0.0%	33.3%	0.0%	33.3%	0.0%
Stevens	100.0%	0.0%	60.0%	100.0%	86.7%	100.0%
Sumner	90.9%	0.0%	60.0%	75.0%	53.1%	100.0%
Thomas	80.0%	0.0%	37.5%	33.3%	61.5%	100.0%
Trego	25.0%	0.0%	0.0%	0.0%	54.5%	50.0%
Wabaunsee	0.0%	0.0%	33.3%	0.0%	62.5%	100.0%
Wallace	100.0%	0.0%	50.0%	100.0%	75.0%	100.0%
Washington	100.0%	0.0%	70.0%	0.0%	60.9%	100.0%
Wichita	75.0%	0.0%	100.0%	100.0%	66.7%	0.0%
Wilson	28.6%	0.0%	62.5%	50.0%	58.3%	0.0%
Woodson	100.0%	0.0%	100.0%	100.0%	80.0%	100.0%
Wyandotte	34.8%	75.0%	38.5%	23.5%	28.3%	71.4%
Statewide Average	59.4%	13.1%	55.9%	51.2%	53.5%	75.7%

Data Limitation Statement: As of October, 2010, the Adjutant General's GIS Department has interns mapping county facilities. State facilities will follow within the next three years. This will give us actual numbers, where facilities are located in hazardous areas, as well as the ability to map all critical facilities, state, county and local. The next mitigation plan update will include this information. Please reference Chapter 5 for mitigation project specifics.

Development in Hazard-Prone Areas

The extent of development pressures near hazardous materials fixed facilities is unknown.

3.3.11 Land Subsidence

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.65	12 of 22	**Moderate**

Description
Subsidence is caused when the ground above manmade or natural voids collapses. Subsidence can be related to mine collapse, water and oil withdrawal, or natural causes such as shrinking of expansive soils, salt dissolution (which may also be related to mining activities), and cave collapses. The surface depression is known as a sinkhole. If sinkholes appear beneath developed areas, damage or destruction of buildings, roads and rails, or other infrastructure can result. The rate of subsidence, which ranges from gradual to catastrophic, correlates to its risk to public safety and property damage.

Areas of karst, a terrain or type of topography generally underlain by soluble rocks, such as limestone, gypsum, and dolomite, in which the topography is chiefly formed by dissolving the rock, are particularly prone to sinkholes.

Some isolated incidents of subsidence have been associated with high volume pumping of water wells. This type of subsidence is not widespread in Kansas and can usually be addressed on a case-by-case basis.

Location
The subsidence risk is highest in the southeast corner of the state, where subsidence events are primarily due to coal, lead, and zinc mining. The risk is considered to be somewhat less in the large central area of the state, where subsidence is often due to dissolution in subsurface salt layers. The lowest relative risk of subsidence is in the western part of the state and in areas along the Nebraska border.

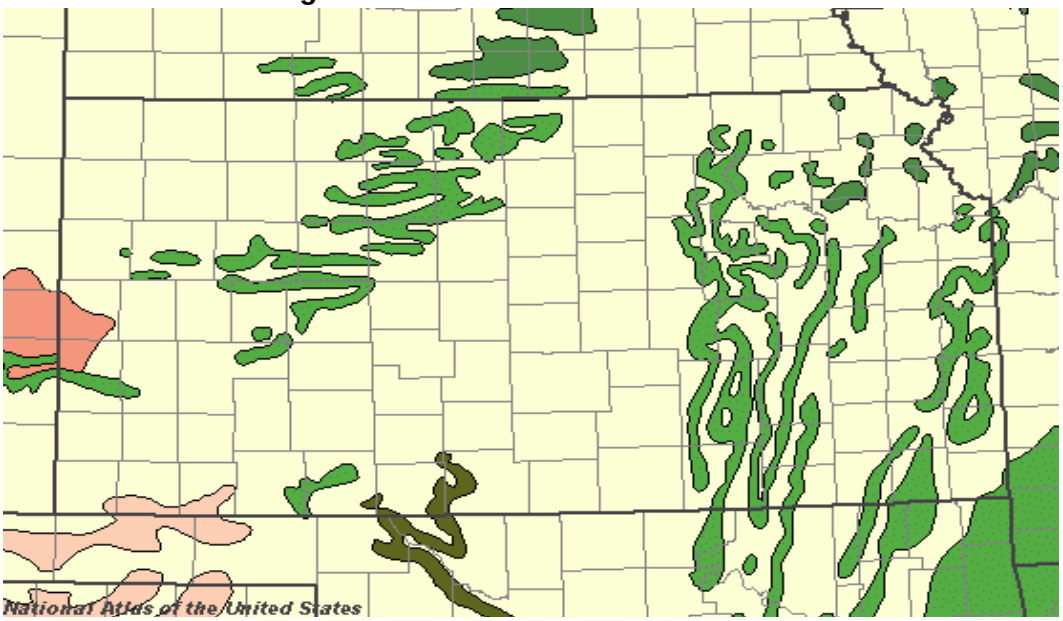
Overall, approximately 46,000 acres in 41 counties have been affected by coal mining in Kansas, including 1,142 acres of mining-related subsidence under towns and roads. The most important coal mining in the state was in southeast Kansas where coal beds were extensively mined in portions of Cherokee, Crawford, and Bourbon Counties. In many locations in southeastern Kansas, the location and extent of abandoned mine passages are not known. Subsidence from abandoned lead-zinc mines is also a problem in Cherokee County (in Galena in particular).

Underground limestone mines have contributed to a subsidence problem in the Kansas City metropolitan area. Natural land subsidence from dissolution of salt occurs in Sumner, Sedgwick, Reno, and McPherson Counties. Subsidence has also been associated with water withdrawal, predominantly in the western and central parts of the state that overlie the High Plains Aquifer.

Figure 3.48 illustrates the location of karst features in Kansas and Figure 3.48 shows one-mile square sections of land in the eastern half of Kansas where sinkhole locations have been documented in the literature. Sections in red indicate sinkhole occurrences (yellow indicates springs). The green areas shown in the map in Figure 3.47 show fissures, tubes, and caves generally less than 1,000 feet long with 50 feet or less vertical extent in gently dipping to flat-

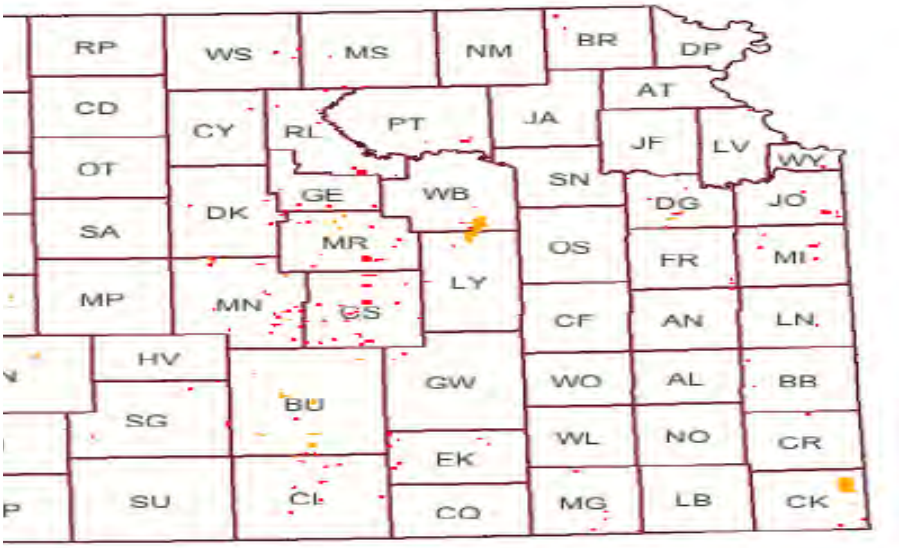
lying carbonate rock. Brown areas have similar features in gently dipping to flat lying gypsum beds. Light pink colored areas are features analogous to karst with fissures and voids present to a depth of 250 feet or more in areas of subsidence from piping in thick unconsolidated material. Darker pink areas contain fissures and voids to a depth of 50 feet. There are limited documented problems associated with limestone subsidence and sinkholes in Kansas.

Figure 3.48 Karst Features in Kansas



Source: U.S. Geological Survey, mapped by the National Atlas of the United States, www.nationalatlas.gov

Figure 3.49. Sinkholes in Eastern Kansas



Source: Kansas Geological Survey

Previous Occurrences

Numerous land subsidence events are recorded in Kansas every year. The Kansas Department of Health and Environment receives about 100 reports a year on coal mine subsidence alone. However, the reports often show little or no damage and/or casualties and were not made available to the 2010 planning team.

Subsidence Events

- 2010 – Kansas City, MO. - Ramps to a major highway shut down because of a growing sinkhole in the pavement. I-470 westbound near the Three Trails Interchange is closed because of a partial collapse where Westbound I-470 meets westbound I-435.
- 2006—A mine collapse occurred in an alley behind the Green Parrot Bar in downtown Galena (Cherokee County). Subsidence from an abandoned lead and zinc mine took the alley and the 114-year old building with it.
- 1998–1999—Two medical buildings were damaged in Wyandotte County.
- 1965–1966— Subsidence over abandoned limestone mines in Wyandotte County damaged roads and destroyed houses.
- Two active sinkholes along a short stretch of I-70 in Russell County have been pulling down the driving lanes since the highway's construction in the mid-1960s. They are the result of dissolution of a salt bed below the surface. An improperly capped abandoned oil well allowed fresh water to pass through and dissolve the salt. The areas have been regraded at significant cost, and efforts were made to stop the subsidence at one of the sinkholes, but the lanes continue to drop. Eventually, a nearby bridge (one end of which has dropped over six feet since it was built in 1965) will have to be replaced because of the subsidence.
- 1959—A circular pit 300 feet in diameter and 85 feet deep developed in a few hours around a plugged and abandoned salt water disposal well (related to oil drilling) southeast of Hutchinson and required the relocating of railroad tracks.
- Other subsidence events related to salt mining were recorded in 1914 southwest of Hutchinson, in 1952 southeast of Hutchinson, and there again in 1974 and 2005. Another collapse occurred near Ellsworth in 1972.

Probability

Based on historical records, land subsidence events occur in Kansas on an annual basis. This hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

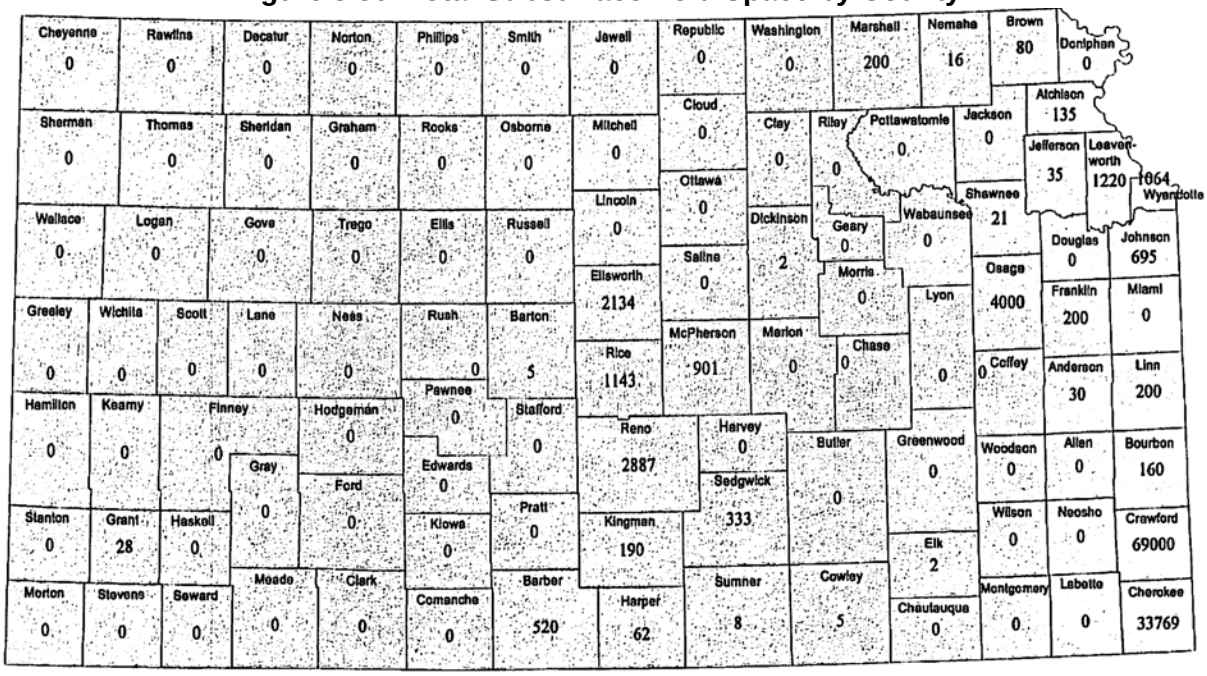
Hazard	Land Subsidence Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

Based on past events, Cherokee, Crawford, Bourbon, Ellsworth, Kiowa, McPherson, Reno, Russell, Sumner, Sedgwick, and Wyandotte Counties are at risk to subsidence problems. The Kansas Department of Health and Environment estimates over 500 shafts in Cherokee County will require corrective action to avoid future cave-ins. According to the sinkhole map, Brown, Butler, Chase, Clay, Cowley, Dickinson, Douglas, Elk, Geary, Greenwood, Johnson, Pottawatomie, Marion, Marshall, Miami, Montgomery, Morris, Riley, Sedgwick, and Washington Counties are potentially at risk to subsidence problems. The southeastern corner of the state is thought to have the highest risk due to the coal, lead and zinc mining activity there.

The Kansas Department of Health and Environment in 2006 prepared a report on "Subsurface Void Space and Sinkhole/Subsidence Area Inventory for the State of Kansas." The report inventoried subsurface void space from oil and gas exploration and production, natural sources, shaft mining, and solution mining. Subsurface hydrocarbon storage caverns are located in Rice, Reno, McPherson, Kingman, Grant, and Ellsworth Counties, and total 2,022 acres of subsurface void space. The total void space inventory for all sources in the state is 119,045 acres. The distribution by county is shown in Figure 3.50.

Figure 3.50. Total Subsurface Void Space by County



Source http://www.engg.ksu.edu/CHSR/outreach/tosnac/sites/docs/04.pdf

There is not enough information to support estimates of future losses from subsidence on a county-by-county basis. The potential for structure damage and economic impacts will be more isolated compared to other hazards, but future disruptions to transportation and other infrastructure as well as structural damage are possible.

Development in Hazard-Prone Areas

Wyandotte, Johnson, Miami, Butler, and Chase Counties are experiencing growth and have subsidence hazard potential. It is not known if growth is occurring in potential subsidence hazard areas.

3.3.12 Landslide

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.20	18 of 22	**Moderate**

Description

Landslides are natural phenomena that are not new to Kansas. A landslide is the downhill movement of masses of soil and rock by gravity. The basic ingredients for landslides are gravity, susceptible soil or rock, sloping ground, and water. Types of landslides that occur in Kansas are rockfalls, block slides, slumps, earth flows, and creep. Creep is widespread on hillsides throughout Kansas.

Landslides require hilly terrain. Typically, as the slope angle increases, so does the potential for landslides. Anything that increases the slope angle can trigger a landslide (e.g., a stream actively eroding a hill, construction practices). Slope steepness is the primary factor determining slope stability, but soil and rock types are also important. The most common rocks found in Kansas are shales, limestones, and sandstones. Shales—rocks composed of clay- and silt-sized grains—are most often associated with landslides. When shale is near the ground surface where the water content fluctuates, it weathers into a clayey soil that could be landslide prone. Limestones and sandstones exposed in cliffs or roadcuts can pose a risk for rock fall, especially when they overlie shales.

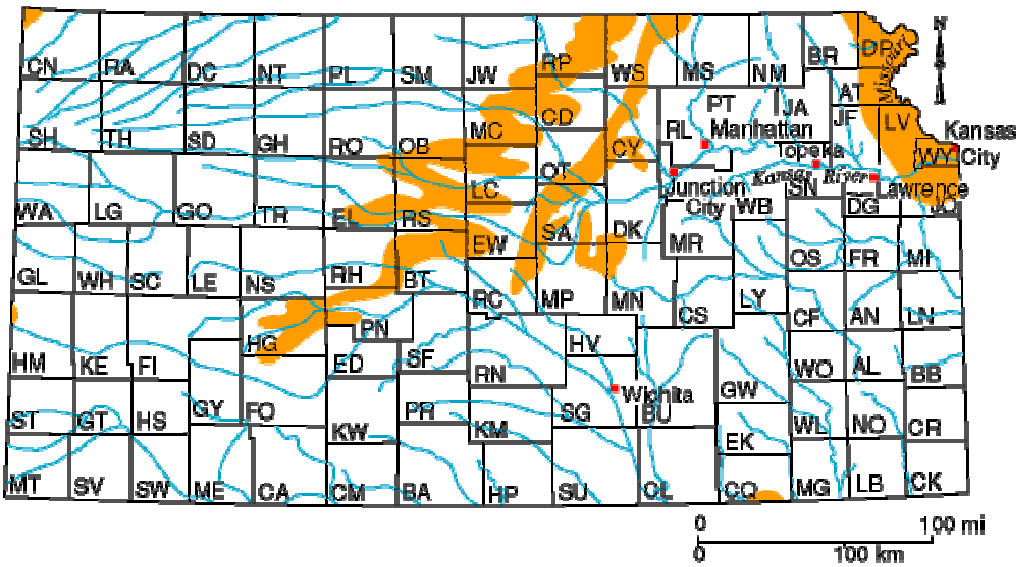
Landslides may occur when soil on hillsides is saturated following extended periods of rainfall or snow melt. Landslides can damage or destroy structures, roadways, and utilities as well as block roadways with debris. They cause more than 25 fatalities and $1.5 billion in damage each year in the United States and are often associated with other hazard events (e.g., earthquakes, flooding, heavy rainfall). There were no reported events in the state from the USGS.

Location

Landslides occur occasionally in Kansas and are a localized problem, but growth of cities provides potential for more property losses. In parts of the state where topographic relief is greatest, especially in central and eastern Kansas, landslides can occur when underlying shales become saturated with water in wet years. Rocks and overlying soils then slip down slope and are a particular problem in areas of housing or where road construction has occurred.

According to the U.S. Geological Survey, the areas of Kansas that are most prone to landslides are the Missouri River Corridor in northeastern Kansas, including the Kansas City metropolitan area (Johnson, Leavenworth, and Wyandotte counties); the Smoky Hills in northern and central Kansas; and northwestern Hamilton County (see Figure 3.51). Though not shown on the map, the region along the Kansas River and its tributaries from Kansas City to Junction City are also landslide prone. This includes the cities of Lawrence, Manhattan, and Topeka. Although landslides are more likely in the regions discussed here, they can occur anywhere in the state.

Figure 3.51. Landslide-Prone Areas of Kansas



Source: Kansas Geological Survey, www.kgs.ku.edu/Publications/pic13/pic13_1.html

More information about location can be found in the Previous Occurrences section as well as the Appendix Q Kansas Landslide Vulnerability.

Previous Occurrences

From 1990-2010, there have been seven reported events from the USGS for landslides, and no major events in the state. Kansas landslides cause structural damage and disrupt transportation on a regular basis. The most costly landslide in Kansas occurred in 1995 in Overland Park. Two houses were destroyed and four lots were damaged. Damage was estimated at $1.15 million. Other Kansas landslides include the following:

- 2007—Flooding caused landslides in southeast Kansas
- 1999—Kansas City
- 1998—$360,000 in damage to a house in Stanley, $170,000 in damage to a road and beach in Douglas County
- 1997—Atchison
- 1995—A landslide closed a road in Manhattan. It cost $880,000 to stabilize the slope and repair the road
- 1994—$310,000 in damage occurred to a city park
- 1990—$120,000 in damage to two houses in Leawood

Probability

Based on the past events between 1990 and 2007, a damaging landslide occurs every 2.4 years; however, there have not been any events from 2007 to 2010. The potential for damaging landslides is more during wet years. This hazard's CPRI probability is **"Likely**" within the next three years.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Landslide Event	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years	x	
	Event has up to 1 in 3 years chance of occurring (1/3=33%)	x	
	History of events is greater than 20% but less than or equal to 33% likely per year	x	
	Event is "Likely" to occur	x	
2 - Possible	Event is probable within the next five years.		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

Overall, the relative risk posed by landslide to Kansas is low, but the level of risk is somewhat higher in the northeast corner of the state in the vicinity of the Kansas City metropolitan area. This includes Wyandotte, Johnson, Leavenworth, Atchison, Douglas and Doniphan Counties.

Development in Hazard-Prone Areas

The Kansas City metropolitan area (Johnson, Wyandotte, and Leavenworth counties) is experiencing higher pressures for new development, which results in construction in or near landslide hazard areas. Even with low to moderate incidence of activity, more structures will be damaged.

3.3.13 Lightning

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.50	14 of 22	Moderate

Description

According to the National Weather Service, lightning is one of the most underrated severe weather hazards. The second deadliest weather killer in the United States, it ranks above hurricanes or tornadoes with an average of 73 deaths and 300 injuries each year.

Lightning in the plains of rural Kansas

Severe thunderstorms strike Kansas on a regular basis. In addition to the heavy rains that cause floods, high winds, tornadoes, and thunderstorms, lightning often accompanies thunderstorms and can cause injury, death, property damage, and wildland fires. The widespread and frequent nature of thunderstorms makes lightning a relatively common occurrence. Of particular concern to Kansas is protection of facilities and communications systems that are important to emergency response operations, protection of public health, and maintenance of the state's economy. The threat to communications systems includes tornado sirens, which could get knocked out just when they are needed most.

Location

Most of Kansas has an average of 30 to 50 thunderstorm days each year; however, most of the eastern counties have annual averages of 50-70 thunderstorm days (see Figure 3.52).

Figure 3.52. Distribution and Frequency of Thunderstorms

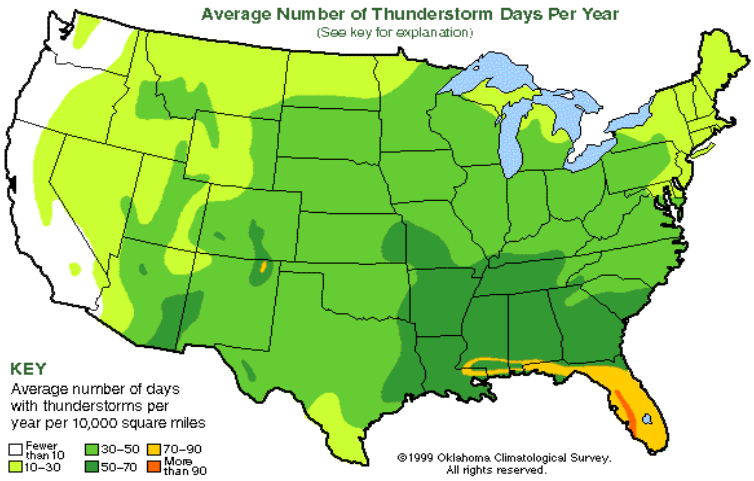
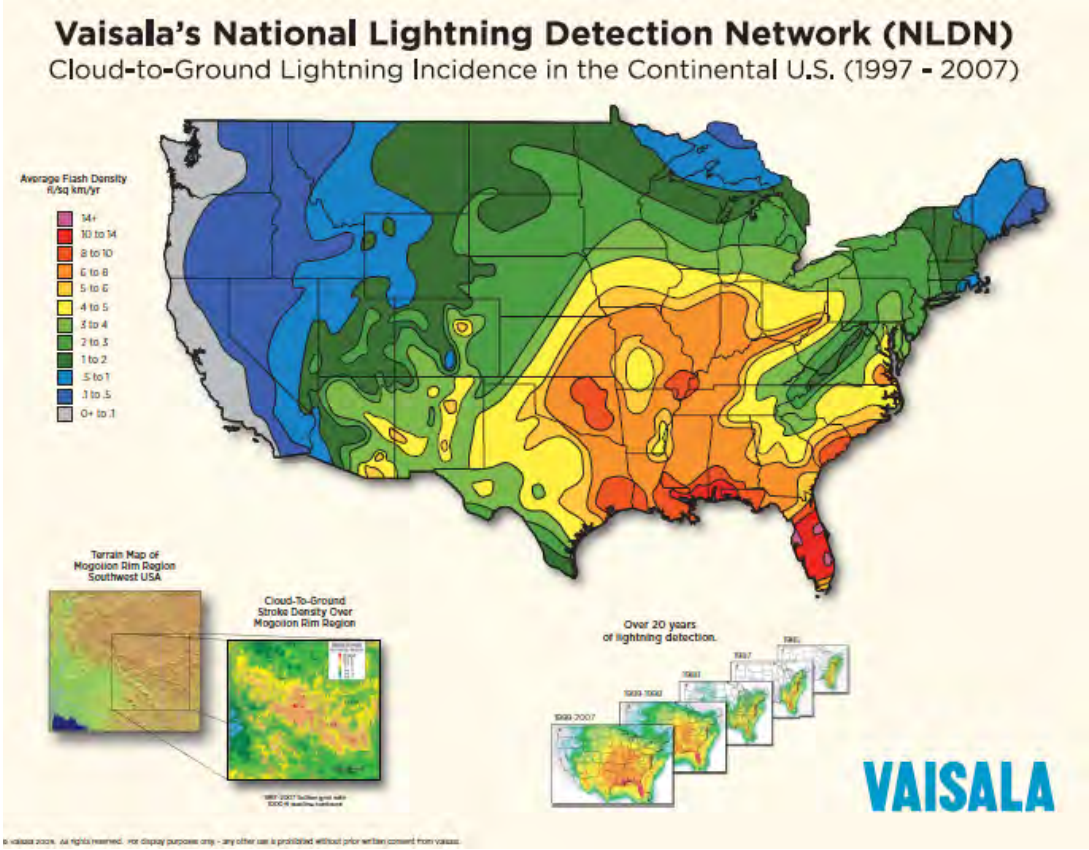


Figure 3.53, which is based on data from 1997 to 2007, shows that the distribution of lightning in the state somewhat follows the pattern of thunderstorm frequency. There are only one to two strikes per square kilometer per year in the west and northwestern counties, while the eastern and southeastern counties experience approximately four to eight strikes per square kilometer per year. Despite these differences, the KHMT considers the threat posed by lightning to be generally uniform across the state.

More information can be found in Appendix R Kansas Lightning Vulnerability.

Figure 3.53. Location and Frequency of Lightning in Kansas



Source: Vaisala

Previous Occurrences

Information measured by the National Lightning Detection Network between 1996 and 2005 ranks Kansas 18th among the continental states in terms of cloud-to-ground flash densities with 851,520 flashes per year (10.4 flashes per square mile). According to the National Climatic Data Center Storm Events database, there were 334 lightning events in Kansas between 1993 and 2010 that resulted in fatality, injury, and/or property and crop damage

Lightning strikes in the Wichita area

(events that do not cause fatalities/injuries or damage are not reported). Total property and crop damage for these events is estimated at $20 million. There were eight deaths and 39 injuries in this time period. This suggests that Kansas experiences an average of 19 damaging lightning events, $1.17 million in lightning-related losses, and two lightning-related injuries each year. Longer-term data exists for lightning-related deaths and injuries only. Figures 3.54 and 3.55 show Kansas lightning deaths and injuries in Kansas. Based on this data, there is roughly one death and four injuries as a result of lightning in Kansas per year, on average (based on 61 deaths and 197 injuries in a 48-year time period).

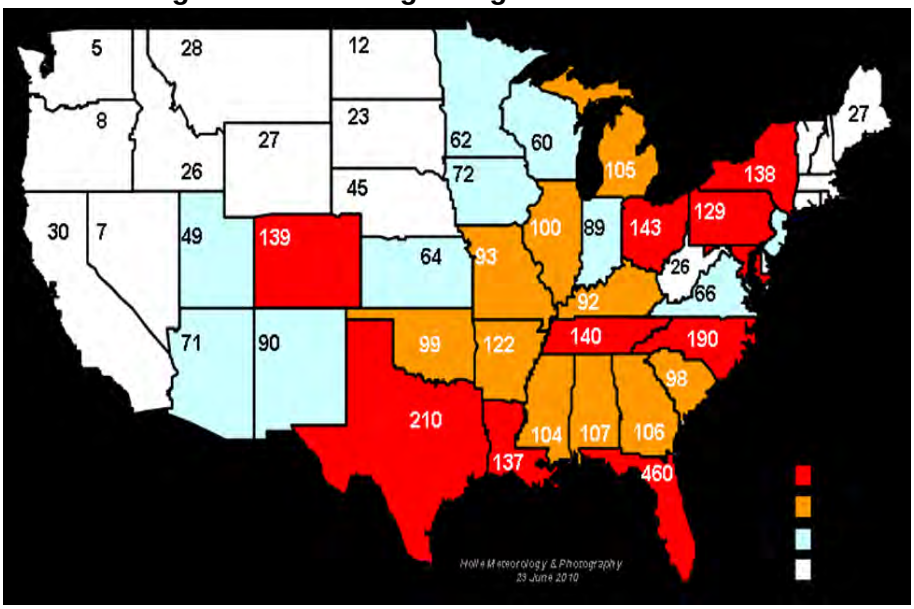
Notable Lightning Events:

- August 27, 2009 - A rural home a few miles east of Arkansas City was destroyed by fire after being hit by lightning during the early morning hours. No one was injured. The Winfield Daily Courier contributed to this report**.**

- December 27 2008 - Lightning from a broken line of strong to severe thunderstorms sparked a house fire in the community of Colony during the predawn hours of the 27th. The residence was completely destroyed. Fortunately, no one was home at the time. Information courtesy of the Iola Register.

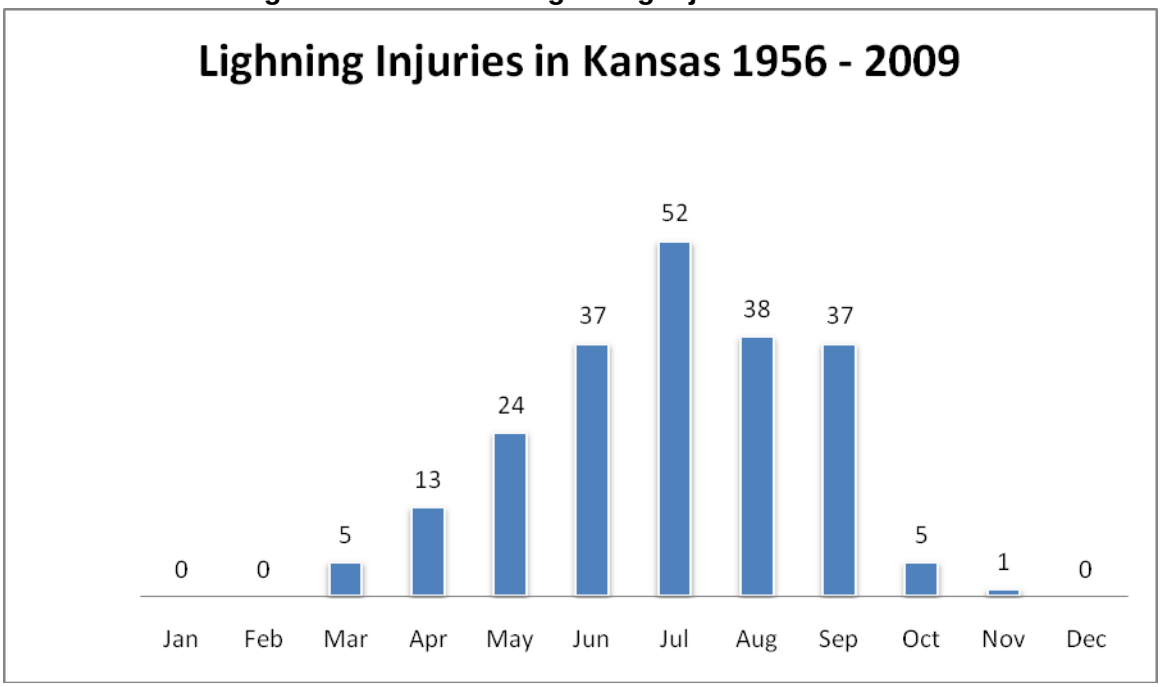
- August 25, 2006 - A lightning strike set a 14-unit building on fire at Twin Lakes Apartment Complex. The fire destroyed the roof and top floors of the building. Fortunately, no one was injured from the blaze. Information courtesy of the Wichita Eagle.

Figure 3.54 U.S. Lightning Deaths 1959–2009



Source: NOAA, 2010 http://www.lightningsafety.noaa.gov/stats/59-09_fatalities_rates.pdf

Figure 3.55. Kansas Lightning Injuries 1959–2009



Source: National Weather Service, NCDC, graph prepared by Bold Planning Solutions

Probability

According to the National Climatic Data Center Storm Events database, there were 334 lightning events in Kansas between 1993 and 2010 that resulted in fatality, injury, and/or property and crop damage (events that do not cause fatalities/injuries or damage are not reported). Based on this information, the probability that at least one damaging lightning event will occur in Kansas in any given year is 100%. This hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Local Plan Integration

For the 2010 update, the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.62.

Table 3.62.Local Plan Statistics for Lightning Events

County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	Low	3	$10,000.00	N/A	N/A	N/A
Brown	Low	8	N/A	N/A	N/A	N/A
Butler	Moderate	4	$100,000.00	N/A	2	N/A
Chase	N/A	N/A	N/A	N/A	N/A	N/A
Cherokee	Moderate	2	N/A	N/A	N/A	N/A
Cloud	Moderate	2	$1,300.00	N/A	N/A	N/A
Cowley	High	8	$106,000.00	N/A	N/A	N/A
Crawford	Low	N/A	N/A	N/A	N/A	N/A
Dickinson	Moderate	10	$168,000.00	N/A	N/A	N/A
Douglas	Moderate	29	$284,000.00	N/A	N/A	N/A
Elk	Moderate	2	$50,000.00	N/A	N/A	N/A
Ellsworth	Low	N/A	N/A	N/A	N/A	N/A
Harper	Low	2	N/A	N/A	1	N/A
Harvey	Moderate	9	$273,000.00	N/A	N/A	N/A
Jewell	Moderate	N/A	N/A	N/A	N/A	N/A

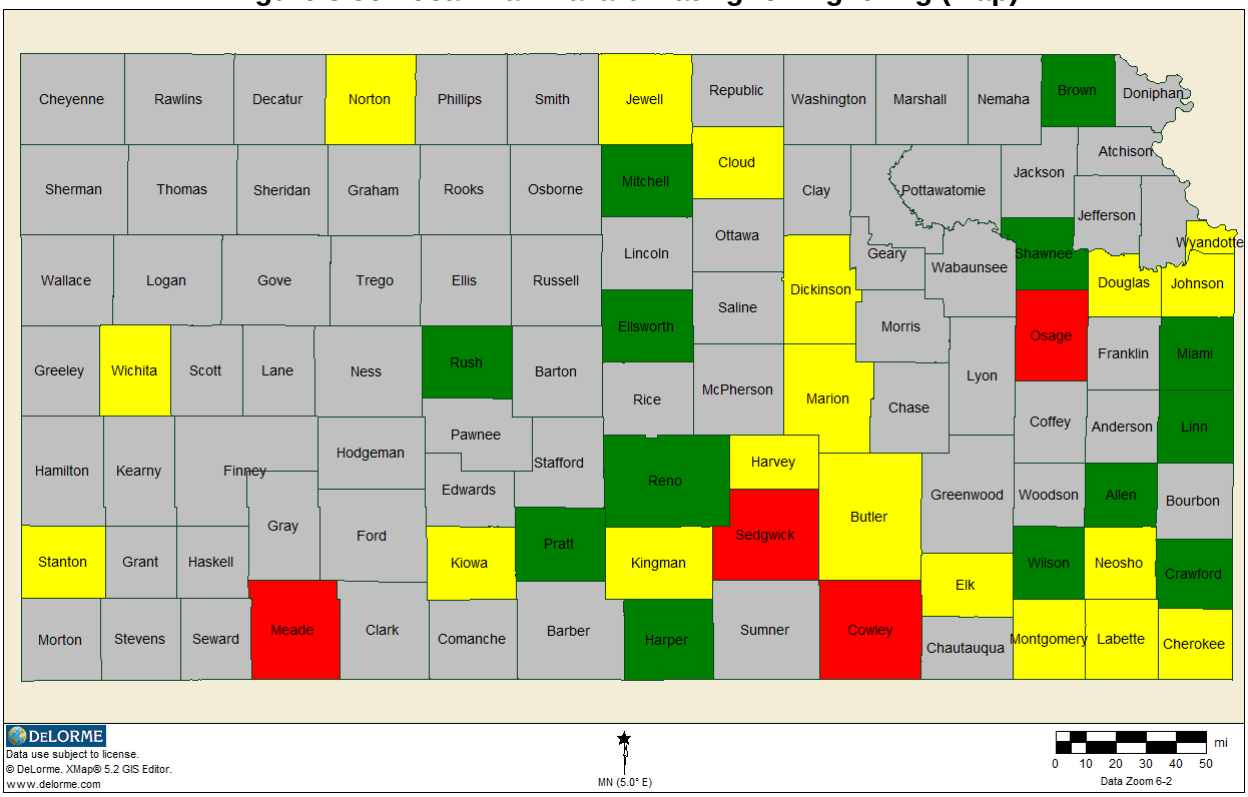
County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Johnson	Moderate	13	$1,459,000.00	N/A	N/A	N/A
Kingman	Moderate	14	$50,000.00	N/A	N/A	N/A
Kiowa	Moderate	8	$158,776.00	$147,814.00	N/A	N/A
Labette	Moderate	5	$82,000.00	N/A	N/A	N/A
Linn	Low	N/A	N/A	N/A	N/A	N/A
Lyon	N/A	N/A	N/A	N/A	N/A	N/A
Marion	Moderate	N/A	N/A	N/A	N/A	N/A
Meade	High	N/A	N/A	N/A	N/A	N/A
Miami	Low	N/A	N/A	N/A	N/A	N/A
Mitchell	Low	N/A	N/A	N/A	N/A	N/A
Montgomery	Moderate	6	$166,000.00	N/A	N/A	N/A
Neosho	Moderate	N/A	N/A	N/A	N/A	N/A
Norton	Moderate	2	$15,000.00	N/A	N/A	N/A
Osage	High	18	$285,206.00	$97,362.00	N/A	N/A
Pratt	Low	N/A	N/A	N/A	N/A	N/A
Reno	Low	7	$146,000.00	N/A	1	N/A
Rush	Low	2	$500,000.00	N/A	N/A	N/A
Scott	N/A	N/A	N/A	N/A	N/A	N/A
Sedgwick	High	9	$2,300,000.00	N/A	3	2
Shawnee	Low	N/A	N/A	N/A	N/A	N/A
Stanton	Moderate	2	N/A	N/A	N/A	N/A
Stevens	N/A	N/A	N/A	N/A	N/A	N/A
Wichita	Moderate	N/A	N/A	N/A	N/A	N/A
Wilson	Low	3	$660,000.00	N/A	N/A	N/A
Wyandotte	Moderate	33	$3,800,000.00	N/A	N/A	N/A
Total		**201**	**$10,614,282.00**	**$245,176**	**7**	**2**

After reviewing the data from the local plans throughout the State of Kansas, the committee calculated averages for lightning. As shown in the table located below, the state can expect an average of $54,027 in damages from a single lightning event. This number can be misleading because a large portion of lightning events are not reported to the NCDC. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.63.Local Plan Averages for Lightning Events

	Deaths	Injuries	Total Damages
Totals	2	7	$10,859,458
Average per County	0.05	0.175	$271,486
Average Per Event	0.01	0.035	$54,027

Figure 3.56.Local Plan Hazard Rating for Lightning (Map)



Source: Bold Planning Solutions

Red – High Risk – 4 Jurisdictions
Yellow – Moderate Risk – 19 Jurisdictions
Green – Low Risk – 13 Jurisdictions
Gray – No Plan/No Rating – 69 Jurisdictions

Risk Ranking Details: High, Moderate, and Low risk rankings are derived from FEMA-approved Risk Assessment criteria for local mitigation plans across the State of Kansas. Based on their CPRI, the hazards were separated into three categories of planning significance: High (3.0-4.0), Moderate (2.0-2.95), and Low (1.1-1.95) at the local jurisdiction level. Please review entire CPRI ranking methodology on page 3.25.

Vulnerability and Potential Losses by Jurisdiction

Based on NCDC data, Kansas can expect approximately $1.3 million in lightning-related losses and two lightning related injuries each year. The eastern and central portions of the state are more likely to experience lightning impacts, but the entire state is susceptible. More injuries and deaths can be expected as a result of lightning strikes during the months of May-September, with the greatest risk to people outdoors for work or recreation. Risk to specific communications, power and warning infrastructure are best conducted on a facility-by-facility basis. Risk assessments conducted on certain state infrastructure is addressed in Section 3.4 State Facilities: Vulnerability of Potential Losses.

Development in Hazard-Prone Areas

Development in the state potentially increases the lightning risk to infrastructure associated with it.

3.3.14 Major Disease Outbreak

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.25	5 of 22	**High**

Description
While there are a number of biological diseases/agents that are of concern to the State of Kansas, the following categories of disease are being addressed in this plan: vaccine preventable disease, food borne disease, and community associated infections as having significant recurring impact on the morbidity of Kansans. The following descriptions are generalized for the specific disease and it should be noted that individuals may experience more or less severe consequences based upon their own circumstances.

Vaccine Preventable Disease
Measles
Measles (rubeola) is a respiratory disease caused by a virus. The disease of measles and the virus that causes it share the same name. The measles virus normally grows in the cells that line the back of the throat and lungs. Measles typically causes fever, runny nose, cough and a rash all over the body.

About one out of 10 children with measles also gets an ear infection, and up to one out of 20 gets pneumonia. About one out of 1,000 gets encephalitis, and one or two out of 1,000 die. While measles is almost gone from the United States, it still kills nearly 200,000 people each year around the world. Measles can also make a pregnant woman have a miscarriage or give birth prematurely. Measles spreads through the air by breathing, coughing or sneezing. It is so contagious that any child who is exposed to it and is not immune will probably get the disease.

Mumps
Mumps is a contagious disease that is caused by the mumps virus. Mumps typically starts with a few days of fever, headache, muscle aches, tiredness, and loss of appetite, and is followed by swelling of salivary glands. Anyone who is not immune from either a previous mumps infection or from vaccination can get mumps.

Most people with mumps recover fully. However, mumps can occasionally cause complications, and some of them can be serious. Complications may occur even if a person does not have swollen salivary glands (parotitis) and are more common in people who have reached puberty.
Complications of mumps can include:

- Inflammation of the testicles (orchitis) in males who have reached puberty, which rarely leads to sterility
- Inflammation of the brain (encephalitis) and/or tissue covering the brain and spinal cord (meningitis)
- Inflammation of the ovaries (oophoritis) and/or breasts (mastitis) in females who have reached puberty
- Temporary or permanent deafness

Pertussis
Pertussis is a highly communicable, vaccine-preventable disease that lasts for many weeks and is typically manifested in children with paroxysmal spasms of severe coughing, whooping, and posttussive vomiting. Major complications are most common among infants and young children and include hypoxia, apnea, pneumonia, seizures, encephalopathy, and malnutrition. Young children can die from pertussis and 10 children died in the United States in 2007. Most deaths occur among unvaccinated children or children too young to be vaccinated. Children who are too young to be fully vaccinated and those who have not completed the primary vaccination series are at highest risk for severe illness. Like measles, pertussis is highly contagious with up to 90% of susceptible household contacts developing clinical disease following exposure to an index case. Adolescents and adults become susceptible when immunity wanes, but can receive a booster shot of the new combination vaccine called Tdap.

Influenza
Influenza (flu) is a viral infection of the nose, throat, bronchial tubes, and lungs. There are two main types of virus: A and B. Each type includes many different strains, which tend to change each year. In Kansas, influenza occurs most often in the winter months. Illnesses resembling influenza may occur in the summer months, but these are usually the result of other viruses that exhibit symptoms commonly referred to as influenza-like illness or ILI.

Influenza is highly contagious and is easily transmitted through contact with droplets from the nose and throat of an infected person during coughing and sneezing. Typical symptoms include headache, fever, chills, cough, and body aches. Although most people are ill for only a few days some may have secondary infections, such as pneumonia, and may need to be hospitalized. Anyone can get influenza, but it is typically more serious in the elderly and people with chronic illnesses such as cancer, emphysema, or diabetes or weak immune systems. It is estimated that thousands of people die each year in the United States from flu or related complications.

Pandemic Influenza
A pandemic is a global disease outbreak. A pandemic flu is a human flu that causes a global outbreak, or pandemic, of serious illness. A flu pandemic occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine.

This disease spreads easily person-to-person, causes serious illness, and can sweep across the country and around the world in a very short time. The Centers for Disease Control and Prevention (CDC) has been working closely with other countries and the World Health Organization to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with pandemic planning and preparation.

During 2009 and 2010 health professionals around the globe worked to combat the H1N1 influenza virus. This relatively mild and stable influenza virus circulated across the globe and caused one of the most robust worldwide vaccination campaigns since the 1970s. Health professionals continue to monitor the possibility of an avian (bird) flu pandemic associated with a highly pathogenic avian H5N1 virus. Since 2003, avian influenza has been spreading through Asia. A growing number of human H5N1 cases contracted directly from handling infected poultry have been reported in Asia, Europe, and Africa, and more than half the infected people have died. There has been no sustained human-to-human transmission of the disease, but the concern is that H5N1 will evolve into a virus capable of human-to-human transmission.

An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Food borne Disease

Norovirus

Noroviruses are a group of related, single-stranded RNA, non-enveloped viruses that cause acute gastroenteritis in humans. The most common symptoms of acute gastroenteritis are diarrhea, vomiting, and stomach pain. Norovirus is the official genus name for the group of viruses previously described as “Norwalk-like viruses” (NLV).

The incubation period for norovirus-associated gastroenteritis in humans is usually between 24 and 48 hours, but cases can occur within 12 hours of exposure. Norovirus infection usually presents as acute-onset vomiting, watery non-bloody diarrhea with abdominal cramps, and nausea. Low-grade fever also occasionally occurs, and diarrhea is more common than vomiting in children. Dehydration is the most common complication, especially among the young and elderly, and may require medical attention. Symptoms of norovirus infection usually last 24 to 72 hours.

Recovery is usually complete and there is no evidence of any serious long-term sequelae. Studies with volunteers given the virus have shown that asymptomatic infection may occur in as many as 30% of infections, although the role of asymptomatic infection in norovirus transmission is not well understood.

Noroviruses are transmitted primarily through the fecal-oral route, either by consumption of fecally contaminated food or water or by direct person-to-person spread. Environmental and fomite contamination may also act as a source of infection. Good evidence exists for transmission due to aerosolization of vomitus that presumably results in droplets contaminating surfaces or entering the oral mucosa and being swallowed. No evidence suggests that infection occurs through the respiratory system.

Noroviruses are highly contagious and as few as 10 viral particles may be sufficient to infect an individual. During outbreaks of norovirus gastroenteritis, several modes of transmission have been documented; for example, initial food borne transmission in a restaurant, followed by secondary person-to-person transmission to household contacts. Although pre-symptomatic viral shedding may occur, shedding usually begins with the onset of symptoms and may continue for two weeks or more after recovery. It is unclear to what extent viral shedding over 72 hours after recovery signifies continued infectivity.

Salmonellosis

Salmonellosis is an infection with bacteria called *Salmonella*. Most persons infected with *Salmonella* develop diarrhea, fever, and abdominal cramps 12 to 72 hours after infection. The illness usually lasts four to seven days, and most persons recover without treatment. However, in some persons, the diarrhea may be so severe that the patient needs to be hospitalized. In these patients, the *Salmonella* infection may spread from the intestines to the blood stream, and then to other body sites and can cause death unless the person is treated promptly with antibiotics. The elderly, infants, and those with impaired immune systems are more likely to have a severe illness.

Salmonella is actually a group of bacteria that can cause diarrheal illness in humans. They are microscopic living creatures that pass from the feces of people or animals to other people or other animals. There are many different kinds of *Salmonella* bacteria. *Salmonella* serotype

Typhimurium and *Salmonella* serotype Enteritidis are the most common in the United States. *Salmonella* germs have been known to cause illness for over 100 years. They were discovered by an American scientist named Salmon, for whom they are named.

Many different kinds of illnesses can cause diarrhea, fever, or abdominal cramps. Determining that *Salmonella* is the cause of the illness depends on laboratory tests that identify *Salmonella* in the stool of an infected person. Once *Salmonella* has been identified, further testing can determine its specific type.

Community-Associated Infections

Methicillin-resistant Staphylococcus Aureus (MRSA)

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of staph bacteria that does not react to certain antibiotics and will normally cause skin infections, but MRSA can also cause other infections including pneumonia. MRSA can also be fatal. In 1974, MRSA infections accounted for two percent of the total number of staph infections; in 1995 it was 22%; in 2004 it was 63%. The CDC estimated that 94,360 invasive MRSA infections occurred in the United States in 2005; 18,650 of these were associated with death.

MRSA is resistant to antibiotics including methicillin, oxacillin, penicillin, and amoxicillin. Since these strong drugs are not effective with MRSA, these infections are sometimes called Multidrug-Resistant Organisms (MDROs). Staph infections, including MRSA, occur most often among people in hospitals and healthcare facilities (such as nursing homes and dialysis centers) who have weakened immune systems. The infection can be spread by skin-to-skin contact, sharing or touching a personal item with someone with infected skin, or touching a surface or item that has been in contact with someone with MRSA.

MRSA infections that occur in otherwise healthy people who have not been recently (within the past year) hospitalized or had a medical procedure (such as dialysis, surgery, catheters) are known as community-associated MRSA infections (CA-MRSA). These infections are usually skin infections such as abscesses, boils, and other pus-filled lesions, but these infections may also lead to more serious illness, such as pneumonia.

Most staph infections, including MRSA, will grow as a bump or infected area on the skin. You should look for skin that is:

- Red
- Swollen
- Painful
- Warm to the touch
- Full of pus or other drainage
- Accompanied by a fever

Healthcare-Associated Infections

Healthcare-Associated Infections (HAIs) are a major cause of morbidity, mortality, and excess cost in the U.S. According to the CDC, in 2002 HAIs accounted for an estimated 1.7 million infections and 99,000 deaths. HAIs occur in all settings of care, placing vulnerable populations at higher risk of complications. Kansas currently does not mandate reporting of HAI surveillance information to the state health department.

To address this issue, it is critical for states to develop a sustainable infrastructure that supports surveillance, reporting and improvement by healthcare providers. Assisting hospitals with tracking, reporting, and subsequent reduction of HAIs within their facilities is an important first step to global reduction of the negative impact of HAIs on patients, their families, and the healthcare system. Since the initial report in 2002, rigorous research and development of

effective HAI reduction strategies have increased the momentum for global action to address this issue.

The Kansas Department of Health and Environment recently released the Kansas Healthcare-associated Infections State Plan, http://www.kdheks.gov/epi/download/KS_HAI_Plan_Public.pdf that addresses the current and near future activities related to reducing the amount and burden of HAI in Kansas.

Location

All of Kansas is susceptible to these and other major disease outbreaks. The more densely populated areas, especially in the eastern half of the state, are more susceptible to the diseases that are transmitted person-to-person.

Previous Occurrences

Number of cases, 2007 & 2008

Year	Measles	Mumps	Pertussis	Influenza*	Pandemic Influenza**	Norovirus	Salmonella	Camplyobacter
2008	0	2	57	1941	0		466	399
2007	0	7	39	3660	0	261	402	416

* - based on Influenza-like Illness Network (ILINET) surveillance sites

** - Pandemic Influenza numbers based on ILINET surveillance for 2009 H1N1 Pandemic Influenza

Mumps

From January 2006 to December 2006 there were 986 cases of mumps affecting 73 counties. The peak of cases occurred in April and May of 2006 and many college campuses were affected throughout the State of Kansas. KDHE issued 35 press releases from April through July of 2006 and held a news conference on 4/11/06. To assist with control of this outbreak KDHE provided 10,000 doses of MMR to local health departments at no charge. During this same time period other states in the United States were reporting similar increases in mumps cases. During 2006, 6,584 cases of mumps were reported nationally.

Norovirus

Following a sorority father-daughter luncheon, attendees reported gastrointestinal symptoms. Multiple counties in Kansas and multiple states were involved. The luncheon was held on 9/22/07 and the onset of illness ranged from 9/23/07 to 9/25/07. One clinical specimen was positive for both norovirus and adenovirus.

A norovirus outbreak in a Butler County Middle School was reported on 4/13/07. Ninety-seven individuals were ill with onset of illness from 4/09/07 to 4/13/07. This outbreak was food borne and the taco salad served on 4/10/07 was statistically implicated. There was also some person-to-person transmission.

In 2008, KDHE investigated three norovirus outbreaks at schools in Kansas. The first occurred in Seward County in an intermediate school and was reported to KDHE on 4/2/08. Norovirus primarily spread through food borne transmission but there was some secondary person-to-person transmission. Ninety-two students reported illness with the onset of illness from 3/31/08 to 4/4/08. The only food item that was associated with illness was served at lunch on Monday, 3/31. Statistical analysis demonstrated that eating the pancake-on-a-stick was significantly associated with illness.

The second school outbreak occurred in Shawnee County. This outbreak was reported on 4/18/08 and affected 134 students and faculty. Transmission of norovirus was both food borne and person-to-person. There were multiple menu items that were significantly associated with the illness. The onset of illness ranged from 4/14/08 to 4/22/08. Local media reported on this outbreak investigation on 4/22, 4/23, and 4/28/08.

The third school norovirus outbreak occurred in Reno County and was reported to KDHE on 4/25/08. Thirty-four individuals reported illness with the onset of illness from 4/18/08 to 4/29/08. Transmission of norovirus occurred both by food borne and person-to-person. No implicated food item was determined.

Salmonellosis

Kansas was part of a multistate outbreak investigation of *Salmonella* Tennessee. Nationwide there were 603 cases from 47 states with onset dates of illness that ranged from 8/1/06 to 4/20/07. In Kansas, there were 19 cases identified with onset dates of illness from 8/1/06 to 3/22/07. Product testing did detect the outbreak strain in peanut butter. Nineteen products were positive, one Great Value Peanut Butter and 18 Peter Pan Peanut Butter. In Kansas one product tested positive for the outbreak strain.

On 6/17/08 a Harvey County health department notified KDHE about an increase in *Salmonella* cases in their county. Upon further investigation, it was discovered that all of the ill individuals had eaten at the same Mexican restaurant. A case control study was conducted. Twenty-nine individuals from five counties were ill with the onset of illness from 6/05/08 to 6/18/08. Two foods were associated with the illness, pico de gallo and guacamole. The only common ingredient in both those dishes was tomatoes. The two shipments of tomatoes delivered during this outbreak were from a large distribution facility in McAllen, Texas. This is the same facility that had the positive sample from jalapenos in the *Salmonella* Saintpaul outbreak. All subsequent tomato shipments to the restaurant were from Arizona. A press release was issued by the county and by KDHE. The county issued another press release indicating that it was safe to dine at the restaurant.

Kansas was part of the *Salmonella* Saintpaul multistate outbreak investigation. This multistate outbreak was reported in May 2008 with a cluster of cases in both New Mexico and Texas. At the end of the investigation there were 1,463 cases reported from 43 states with the onset of illness ranging from 4/16/08 to 8/23/08. In Kansas, KDHE investigated 22 cases from 13 counties with the onset of illness ranging from 5/12/08 until 7/13/08. Tomatoes were implicated as the food vehicle early in the outbreak. However, *Salmonella* Saintpaul was never isolated from any tomatoes. Additional investigation revealed that jalapenos and Serrano peppers were both associated with illness and *Salmonella* Saintpaul was isolated from jalapeno peppers. Multiple food vehicles are thought to have caused this outbreak. KDHE issued a press release on June 4, 2008 after the warning was issued from FDA about consumption of tomatoes. A second press release was issued by KDHE on July 9 after the warning from FDA changed to include jalapeno and Serrano peppers.

Campylobacter

In 2007, KDHE investigated two campylobacter outbreaks related to the consumption of raw milk or products made from raw milk. The first outbreak occurred in Kearney County in a religious community. It was reported to KDHE on 10/29/07. Sixty-eight individuals reported gastrointestinal symptoms following a pioneer days' celebration where cheese was made from raw milk donated by a local dairy. This cheese was served at the luncheon held on 10/20/07. The onset of illness ranged from 10/21/07 to 10/29/07.

Influenza

Influenza is an annual occurrence in Kansas through the winter months, typically September to February. Influenza has also been a contributing factor to deaths in Kansas. According to the CDC, ecologic studies have demonstrated temporal relationships between influenza activity and bacterial pneumonia.

	2006-2007 Influenza Season	2007-2008 Influenza Season	2008-2009 Influenza Season
Pneumonia or Influenza – Contributing factor in death	1139	1309	1143
Influenza – Direct cause of death	4	51	5
Pneumonia – Direct cause of death	575	681	463

Pandemic Influenza

There have been four acknowledged pandemics in the past century:

- 1918–19 Spanish flu (H1N1) – This flu is estimated to have sickened 20-40% of the world's population. Over 20 million people lost their lives. Between September 1918 and April 1919, 500,000 Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack rate and mortality was highest among adults 20-50 years old; the reasons for this are uncertain. Recently, the origin of the pandemic was traced to an outbreak of influenza in Haskell County, Kansas, in January 1918. Army personnel in Haskell County reported to Camp Funston (now Ft. Riley), which meant soldiers and their friends and families likely carried the virus from the county to the camp. Camp Funston sent a constant stream of soldiers to other American locations and to Europe, enabling the spread of the disease throughout the country and around the world. By the end of 1918, the Kansas death toll was around 12,000.
- 1957–58 Asian flu (H2N2) – This virus was quickly identified because of advances in technology, and a vaccine was produced. Infection rates were highest among school children, young adults, and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In total, there were about 70,000 deaths in the United States. Worldwide deaths were estimated between one and two million. Information about how this pandemic affected Kansas was not available.
- 1968–69 Hong Kong flu (H3N2) – This strain caused approximately 34,000 deaths in the United States and more than 700,000 deaths worldwide. It was first detected in Hong Kong in early 1968 and spread to the United States later that year. Those over age 65 were most likely to suffer fatal consequences. This virus returned in 1970 and 1972 and still circulates today.
- 2009 H1N1 Influenza – The 2009 H1N1 Pandemic Influenza began in Kansas with the first identified case on April 24, 2009. Kansas was the third state to positively identify this novel strain of influenza and was the first non-border state to confirm a positive identification. During the 2009 H1N1 Pandemic a total of 29 Kansans died as a result of confirmed infection with the disease.

Probability

With the update to the list of diseases and their outbreaks, the probability of a major disease outbreak in the State of Kansas has been update to **"Highly Likely,"** as it is evident that outbreaks occur annually throughout the state.

Vulnerability and Potential Losses by Jurisdiction

The entire state is vulnerable to a major disease outbreak. As evident by Annual Infectious Disease Summaries completed by the KDHE Bureau of Surveillance and Epidemiology

(http://www.kdheks.gov/epi/index.html) all counties in Kansas have connections with one or multiple disease outbreaks a year. Potential casualty losses are anticipated to be greatest in counties with higher populations, higher pediatric populations and higher elderly populations. Health professional shortage areas and rural areas are more susceptible to having limited medical capabilities and by extension are more susceptible to the possibility of being overwhelmed because of a large surge of patients seeking care.

According to *The annual impact of seasonal influenza in the US: Measuring disease burden and costs* by Molinari et al., nationally the economic burden of influenza medical costs, medical costs plus lost earnings, and the total economic burden were $10.4 billion, $26.8 billion and $87.1 billion respectively. Using these numbers versus the gross domestic product and estimating their percentages against the Kansas gross domestic product, we can estimate an annual economic burden to Kansas from influenza medical costs of $89 million, medical costs plus lost earnings of $229 million, and total economic burden of $745 million.

The financial burden of healthcare-associated infections nationally has been estimated at $33 billion annually, a staggering figure in an economy with rising healthcare needs and diminishing reserves.

Development in Hazardous Areas

This is not relevant to this hazard.

3.3.15 Radiological

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
1.95	19 of 22	Low

Description

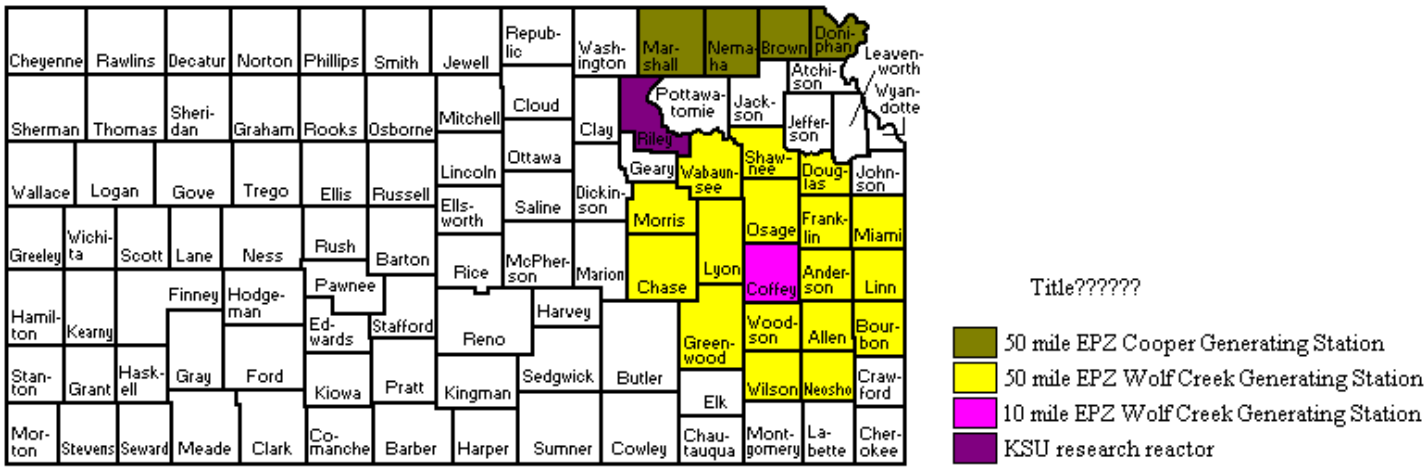
An accident involving radioactive materials could occur in Kansas from a variety of sources: nuclear reactors, transportation accidents (see Section 3.3.10 Hazardous Materials), industrial and medical uses, and lost or stolen sources to which the public could be exposed, or contaminated, with a high level of radiation. Radiological accidents could cause injury or death, contaminate property and valuable environmental resources, as well as disrupt the functioning of communities and their economies. There have been no reported events of this type in the State of Kansas, and all information contained in this hazard profile remains valid and current for the 2010 update.

Aftermath of Chernobyl plant accident

Location

There are several Kansas counties included in 10-mile and 50-mile emergency planning zones (EPZ) for nuclear power plants. There are two commercial plants that could pose a threat to Kansas: The Wolf Creek Nuclear Power Plant in Coffey County and the Cooper Nuclear Station in Nemaha County, Nebraska (southeast).There is also Kansas State University's TRIGA research reactor that supports education, research, training, and regional industries. Figure 3.57 illustrates counties impacted by nuclear power plant emergency planning or the university reactor.

Figure 3.57. Counties Impacted by Nuclear Power Plants or Reactors in Kansas



Source: Kansas Department of Health and Environment

There are over 300 licensees for radioactive material that varies in size from small sources to large sources. Most uses of radioactive materials are spread across the state, though in some relation to population. Diagnostic and therapy medical sources are common at most hospitals. Universities often have some radioactive material for research and education. Commercially used radioactive materials are more common in the eastern third of Kansas. Radioactive materials used in water and hydrocarbon extraction are commonly used in western Kansas.

It is common for materials, including pharmaceuticals, industrial sources, and nuclear fuel rods destined to nuclear reactors, to be transported across Kansas highways and railroads (see map of transportation infrastructure in Section 3.3.10 Hazardous Materials).

Previous Occurrences

There have been several occurrences of radiological accidents in Kansas during operation and transportation of devices and sources. Most notably, none have caused serious injury or death. Incidents include lost and stolen sources, well-logging sources lost down hole, overexposures, and fires involving gauges and materials.

Notable Radiological Events

- March 22, 1979–Transportation spill: At the I-235 underpass near the Meriden Street exit, in Wichita, a truck carrying refined uranium, yellow cake, overturned and several container drums were breached. Soil and the refined uranium were removed, over packed, and shipped to a facility out of the state.
- May 17, 2002–Destroyed moisture/density gauge: A moisture/density gauge was destroyed when it was run over by an earthmover. The case and source rod were intact and undamaged, the guide rod for the source rod was bent.
- July 12, 2005–Destroyed moisture/density gauge: A moisture/density gauge was destroyed when the operator of a passenger car failed to follow a pilot car at a construction site, entered a closed lane, and ran over the gauge while in operation.

Probability

Based on current radiological event data for the State of Kansas, only one actual radiological event has been recorded. Based on this information, this hazard's CPRI probability is "**Unlikely**" within the next ten years.

Based on historical records, multiple HAZMAT events occur every year in the State of Kansas. This hazard's CPRI probability is "**Unlikely**" within the calendar year.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Radiological Event	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x

2 - Possible	Event is probable within the next five years.		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years	x	
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur	x	

Vulnerability and Potential Losses by Jurisdiction

Counties within the 10-mile EPZ for commercial nuclear power plants (in Kansas, this is only Coffey County) have a relatively higher radiological risk than other counties, but the potential for an incident is extremely low. Nemaha, Brown, and Doniphan Counties have moderate vulnerability since they are the closest counties to the Cooper Nuclear Plant in Nebraska. In general, radioactive material is distributed across the state proportionally to population density. Areas near interstates and major highways have an increased risk of transportation accidents. Remote areas also have to account for long response times from hazardous materials and health physics personnel. Stolen and lost sources can put the public at elevated risks if the material is unidentified and lost, abandoned, or intentionally placed in a public area. Field radiography cameras are used extensively in pipeline construction and repair. Along with currently licensed materials, there are a few contaminated sites in Kansas that may pose a risk to public health and the environment.

Development in Hazard-Prone Areas

Federal regulations require emergency planning for the area within up to a 50-mile radius of a nuclear power plant. The two areas affected by this, while experiencing some development and growth, are not increasing in population at such a rate to modify the risk substantially in the near future.

Contaminated sites in urban environments are a concern as often the sewer system and other underground structures can act as conduits for the migration of nonsoluble radionuclides in the subsurface. This should be a consideration for excavation near or down gradient from a known contaminated site.

During all lawful operations of radioactive materials, the licensee is responsible for ensuring that the area around the source material is cordoned off or shielding is used to prevent unnecessary exposures. Inspections of practices and security measures are regularly conducted to ensure compliance and conformity to regulations in order to protect the public. The frequency of inspections can be adjusted in response to perceived risk. Public risk can be reduced by minimizing the duration of exposure, shielding the source material, and maximizing the distance from the source.

3.3.16 Soil Erosion and Dust

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
1.75	20 of 22	Low

Description

Soil erosion and dust are both ongoing problems for Kansas. Both can cause significant loss of valuable agricultural soils, damage crops, harm environmental resources, and have adverse economic impacts. Soil erosion in Kansas is largely associated with periods of drought, when winds are able to move tremendous quantities of exposed dry soil (wind erosion), and flooding (streambank erosion). Improper agricultural and grazing practices can also contribute to soil erosion.

The United States is losing soil 10 times faster than the natural replenishment rate, and related production losses cost the country about $37.6 billion each year. On average, wind erosion is responsible for about 40% of this loss and can increase markedly in drought years. Wind erosion physically removes the lighter, less dense soil constituents such as organic matter, clays and silts. Thus it removes the most fertile part of the soil and lowers soil productivity, which can result in lower crop yields or poorer grade pastures and increase economic costs.

Stream bank erosion, which can remove agricultural land and damage or destroy transportation systems and utility lines, occurs each year, particularly in the spring, and can occur along any stream bank. A large proportion of all eroded soil material ends up in rivers, streams, and lakes, which makes waterways more prone to flooding and contamination. One type of stream bank erosion occurs after heavy rains when water is released from reservoirs causing water levels to rise in rivers and streams. The dry soil at the top of embankments becomes saturated. When reservoir gates are closed and flows return to normal, water levels suddenly drop and the heavy wet soil at the top of the embankments falls into the rivers and streams below.

Federal reservoirs are a vital resource for public water suppliers in Kansas, providing regional sources of stored untreated water to surrounding communities and industries. The silting of these reservoirs is impacting water supply and quality as well as flood storage. Because of differing climatic conditions, land uses, and physical attributes in the various watersheds, sedimentation rates vary among the reservoirs.

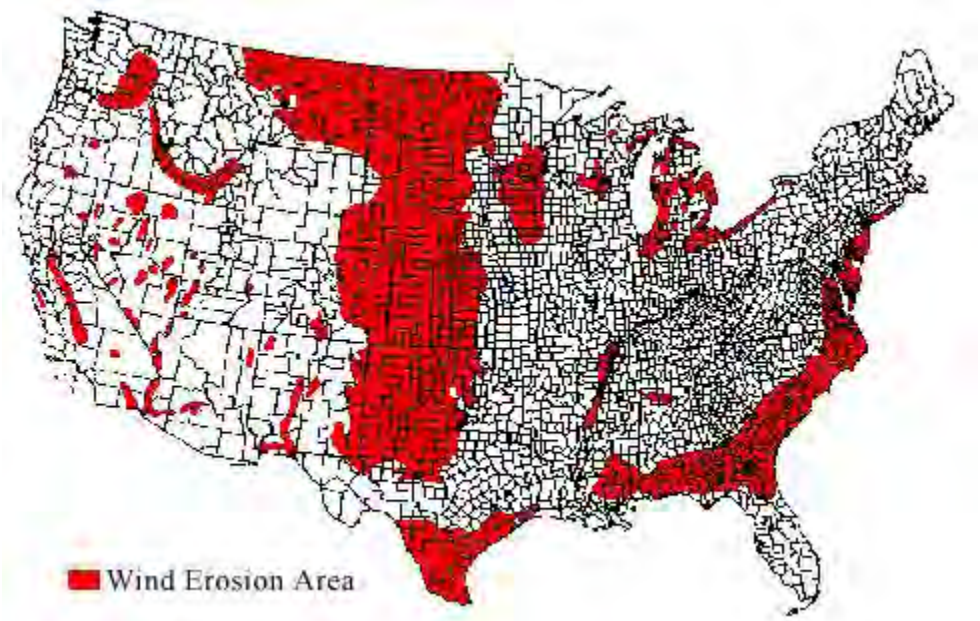
In 2001, the Kansas Water Office completed a report that projected the affect of sedimentation on state-owned storage in federal reservoirs. By the year 2040, sedimentation was projected to reduce the total amount of state-owned storage from 1.2 million acre-feet to roughly 857,000 acre-feet, a rate of loss of 6,260 acre-feet per year.

Erosion increases the amount of dust carried by wind. Dust can also threaten agriculture and have economic impacts by reducing seedling survival and growth, increasing the susceptibility of plants to certain stressors, and damaging property and equipment (e.g., clogging machinery parts). It is also a threat to health and safety. It acts as an abrasive and air pollutant and carries about 20 human infectious disease organisms (including anthrax and tuberculosis). There is evidence that there is an association between dust and asthma. Some studies indicate that as much as 20% of the incidences of asthma are related to dust. Blowing dust can be severe enough to necessitate highway closures because of low visibility, which can cause vehicle accidents. The HMP Committee determined that there is limited data on this hazard, therefore the committee elected not to make any substantial updates to this assessment.

Location

The risk rating for dust or wind erosion is relatively low for the state, with a slightly higher risk defined for the western portion (see Figure 3.58). This higher risk in the western counties of Kansas correlates with the fact that this area of the state has higher wind velocities than central and eastern Kansas. The higher risk in western Kansas is also associated with the economic impacts to agriculture caused by wind erosion and dust. Following the flooding in 1993, silt and sand deposits that accumulated along the bottomlands in central and eastern Kansas were incorporated into topsoil, which increased the soils, and thus the region's, susceptibility to wind erosion.

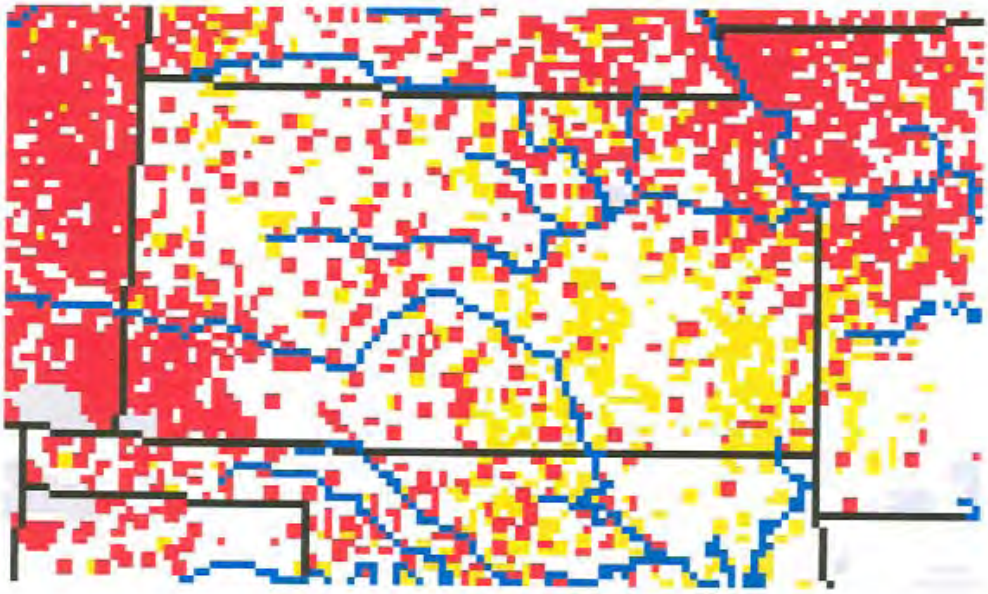
Figure 3.58. United States Wind Erosion Areas



Source: U.S. Department of Agriculture Agricultural Research Service Wind Erosion Research Unit, www.weru.ksu.edu

Figure 3.59 shows areas of excessive erosion of farmland in Kansas based on a 1997 analysis. Each red dot represents 5,000 acres of highly erodible land, and each yellow dot represents 5,000 acres of nonhighly erodible land with excessive erosion above the tolerable soil erosion rate. This map suggests that most of Kansas is experiencing water and wind erosion.

Figure 3.59. Locations of Excessive Erosion of Farmland, 1997



Stream bank erosion is a concern along reaches of several rivers in Kansas, especially downstream of large reservoirs of the Kansas and Nemaha Rivers.

While sediment deposition is a concern at all federal reservoir locations where the state has water storage, the state has not yet ranked their level of concern. The state is in the preliminary stages of modeling future water supply yield from these reservoirs as impacted by sediment deposition. This information along with other information on available water supplies will be compared to water demand projections to determine where the most immediate problems may occur.

Interestingly, the actual sedimentation rates 11 of the 17 reservoirs exceed their design sedimentation rates. The sediment storage for John Redmond Lake, which had a design life for sediment storage of 50 years, was filled in 1988 after just 24 years. Its actual sedimentation rate, 2,075 acre feet per year, is more than two times its design sedimentation rate of 1,020 acre feet per year. The actual sedimentation rate of Marion Lake is 247 acre feet per year, which is also more than two times its design sedimentation rate of 94 acre feet per year.

Previous Occurrences

According to the 2003 Natural Resources Inventory (NRI) by the Natural Resources Conservation Service, Kansas losses 55,211,000 tons of cropland (2.1 tons per acre) to water erosion and 35,449,000 tons (1.3 tons per acre) to wind erosion each year. The NRI also found that of the state's highly erodible cropland (8,100,700 acres, 31% of the state's cropland), 27% of it was eroding above soil loss tolerance rates. Additionally, 11% of the state's non-highly erodible cropland was eroding above soil loss tolerance rates. There were no reported events from the USGS for this hazard and no major events in the state.

Kansas is well known for its role in the 1930s Dust Bowl, in which the Central Plains states suffered drought and resulting wind erosion for about a decade. It is estimated that 21.5 million acres were lost during this time.

On May 29, 2004, severe thunderstorms in northwest Kansas and northeast Colorado and a cold front in northwest Kansas combined to create a huge dust cloud similar to the ones of the Dust Bowl days. Visibility in Wakeeney, Ellis, Ransom, and Alexander dropped to near zero for several hours. Visibilities were reduced to tens of feet in some instances. Traffic on I-70 was adversely affected. Several pileups occurred. Two lives were lost.

In the 1970s, 891,000 acres were lost to wind erosion. In the spring of 1996 wind erosion severely damaged agricultural land throughout the Great Plains.

Probability
While soil erosion and dust occurs annually as part of natural processes, it was determined by the hazard mitigation team that this hazard's CPRI probability for **"notable"** events is "**Likely**" within the next three years.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Soil Erosion and Dust	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years	x	x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)	x	x
	History of events is greater than 20% but less than or equal to 33% likely per year	x	x
	Event is "Likely" to occur	x	x
2 - Possible	Event is probable within the next five years.		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction
Essentially all of Kansas is prone to soil erosion, with the western half of the state more vulnerable to wind erosion and dust because of a greater amount of farmland and higher velocity winds.

Development in Hazard-Prone Areas
Not an applicable factor for this hazard.

3.3.17 Terrorism, Agri-Terrorism, and Civil Disorder

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.65	11 of 22	**Moderate**

Description

The Federal Bureau of Investigation defines terrorism as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." The threat of terrorism, both international and domestic, is ever present, and an attack is likely to occur when least expected.

The Southern Poverty Law Center reported that in 2006, there were six active hate groups in Kansas: Four neo-Nazi groups (National Socialist Movement in Hutchinson, Kansas City, Scandia, and Wichita), one racist skinhead group (Midland Hammerskins in Wichita), and one general hate group (Westboro Baptist Church in Topeka). They also reported one patriot group (opposed to the "New World Order" or advocate, or adhere to extreme antigovernment doctrines): the Constitution Party in Wichita. Other groups, such as the Animal Liberation Front (ALF), Earth Liberation Front (ELF), and People for the Ethical Treatment of Animal (PETA) have sympathizers in the state. Although no major terrorist acts have been attributed to any of these latter groups, their involvement in violent acts is meant to disrupt governmental functions and cannot be discounted.

Agri-terrorism consists of acts to intentionally contaminate, ruin, or otherwise make agricultural products unfit or dangerous for consumption or further use. Agriculture is an important industry in Kansas. The introduction of a biological agent into the population of 6.4 million cattle or the nearly 10 million acres of wheat would be financially devastating and would have a major impact on the food supply of the state and the nation. A major attack involving the nation's food supply could be launched in a rural area that has little capacity to respond. Potential terrorists' targets for livestock disease introduction would be concentration points, such as the state's licensed feedlots livestock markets. Additionally, Kansas has over 120 agricultural crop-dusters, many of which are configured for chemical spraying. (See Section 3.3.1 Agricultural Infestation.)

In the United States, civil disorder has been most commonly associated with urban areas and college campuses, particularly in the 1960s around the issues of civil rights and the Vietnam War. According to U.S. Code (18 U.S.C. §232), civil disorder is "any public disturbance involving acts of violence by a group of three or more persons causing immediate danger, damage, or injury to the property or person of another individual." In Kansas, civil disorder is recognized as a societal hazard because of the associated potential for injury, loss of life, property damage, and economic disruption. There has been very little reported terrorist activity in the State of Kansas; therefore the committee determined this hazard profile to be sufficient for the 2010 update, although certain sections were updated where possible.

Location

No portion of the state is immune from terrorism, agri-terrorism, or civil disorder. The metropolitan areas will be potential targets because of their large populations, but rural areas could be potential agri-terrorism targets. Civil disorder is mostly associated with metropolitan areas, but extremist groups and actions such has school shootings have occurred in rural areas elsewhere in the United States.

Previous Occurrences

The terrorist attacks on September 11, 2001, had nexus to Kansas: Three of the hijackers had at one time possessed Kansas drivers' licenses and at least one had ties to a state university. The subsequent anthrax crisis had a significant effect on Kansas law enforcement and the emergency response community. Hundreds of anthrax-related calls were answered by law enforcement, fire service, and public health personnel. Although there have been no confirmed anthrax cases, the number of calls severally stressed state and local response capabilities and focused attention on training and equipment needs to deal with such incidents.

September 11th, 2001: Picture taken of the South Tower of the World Trade Center just as an aircraft crashed into the building

Although Kansas has been fortunate to escape a major terrorist incident, the state has experienced a number of smaller, less publicized incidents. Since the early 1990s, Kansas has experienced several incidents involving violence attributed to domestic extremist groups or individuals. Anti-abortion groups have been active in Wichita and Topeka. White supremacists have conducted rallies and have been suspected in assaults and cross burnings.

- In 2009, a man shot a well known and controversial doctor, who performed late-term abortions, as he sat in church.
- In 2004, there was a white supremacist rally in Topeka.
- In 1993, a lone gunman attacked the federal courthouse in Topeka with firearms and improvised explosive devices, killing and injuring several individuals. The same individual also set off explosive devices in the courthouse parking lot and at a law enforcement facility parking lot in an adjoining county.
- In 1993, a doctor was killed outside an abortion clinic in Wichita.
- In 1995, Timothy McVey and Terry Nichols used Kansas as a base of operations for their attack in Oklahoma City. It is believed that Kansas City was identified as an alternate site for their attack.

Alfred P. Murrah building in Oklahoma City after the devastating attack in 1995.

- In 1998, Kansas responded to an anthrax hoax against the Finney State Office Building. The hoax resulted in a major evacuation and decontamination of a number of the facility's occupants.
- On March 6, 1988, a heavily armed man opened fire in a church in Emporia, killing one man and injuring four people. No motive was identified.
- On August 11, 1976, a sniper on the 26th floor of the Holiday Inn Plaza in downtown Wichita shot and killed three men, wounded seven other people, and sent dozens more diving for cover. No motive was identified.

While there were reports of college student protests and unrest at the University of Kansas in the 1960s, there is little information about civil disorder in Kansas with the exception of the 1920 Independence Kansas Riots. These racially-based riots erupted following the shooting of a local

White grocer by a man of color and necessitated the deployment of the Kansas National Guard because of the inability of local law enforcement resources to manage the situation. Two people were killed and five injured. Other hate-group-related incidents include threats made by Posse Comitatus and We the People, which, according to the Southern Poverty Law Center, are not currently active in Kansas.

Probability

While difficult to estimate, the CPRI probability for a terrorist, agri-terrorism, or civil disorder event is "**Unlikely**" within the next 10 years. The nation has been on an "elevated" homeland security threat level or higher since September 11, 2001, which means there is a "significant risk of terrorist attacks" somewhere in the United States.

Vulnerability and Potential Losses by Jurisdiction

The level of risk posed by acts of terrorism against nonagricultural facilities and systems is low. This risk is somewhat elevated in the eastern and south central regions of the state, reflecting the greater level of urbanization and the larger number of potential targets.

The state has identified a growing vulnerability to terrorism. To respond to that vulnerability, Kansas faces some unique problems relating to geography and population distribution. A majority of the state's population is concentrated in three metropolitan areas (Kansas City, Topeka, and Wichita). The rest of the state is generally rural and has limited governmental and public health infrastructure. Kansas has four active military installations (Ft. Riley in Junction City, Ft. Leavenworth northeast of Kansas City, McConnell Air Force Base in Wichita, and Forbes Field Air National Guard Base in Topeka) and one active nuclear generating power plant (Coffey County). The northeast corner of the state is within the fifty-mile emergency planning zone of Nebraska's Cooper Nuclear Station. All of these are potential terrorist targets. The metropolitan Kansas City area, besides being a major population center, is home to a nationwide telecommunication provider, Wichita is home to a significant portion of the nation's aerospace industry, and Salina has the Kansas Regional Training Institute training grounds for the Army National Guard and is near a missile range.

The risk of agri-terrorism incidents is relatively higher in the central and western portions of the state. This corresponds with the location of the largest acreage of croplands and cattle range as well as the location of numerous large feedlots (which are in the southwest, see Figure 3.11). It is believed that most communities of the state are not likely to experience civil disorder, barring extraordinary and unpredictable circumstances. The communities considered to be most vulnerable to this hazard are low-income communities, urbanized areas, large gathering places (such as sports stadiums), and universities. As mentioned previously, there are hate/patriot groups in Hutchinson, Kansas City, Scandia, Topeka, and Wichita. It is not possible to predict what or where the future losses may be to terrorism, agri-terrorism, or civil disorder, because of the nature of these hazards. Losses could be small from isolated events, to catastrophic depending on the nature of the event.

Development in Hazard-Prone Areas

This is not relevant to this hazard.

3.3.18 Tornado

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.40	2 of 22	**High**

Description

The National Weather Service defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 mph, and damage paths can be more than one mile wide and 50 miles long. In an average year, more than 900 tornadoes are reported in the United States, resulting in approximately 80 deaths and more than 1,500 injuries. High winds not associated with tornadoes are profiled separately in this document in Section 3.3.21 Windstorm.

Although tornadoes have been documented on every continent, they occur most frequently in the United States east of the Rocky Mountains. Kansas is situated in an area that is generally known as "Tornado Alley." Climatological conditions are such that warm and cold air masses meet in the center of the country to create conditions of great instability and fast-moving air at high pressure that can ultimately result in the formation of tornado funnels.

In Kansas, most tornadoes and tornado-related deaths and injuries occur during the months of April, May, and June. However, tornadoes have struck in every month. Similarly, while most tornadoes occur between 3:00 and 9:00 p.m., a tornado can strike at any time.

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis, and better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado. Table 3.63 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 3.64 shows the wind speeds associated with the Enhanced Fujita Scale ratings. The Enhanced Fujita Scale's damage indicators and degrees of damage can be found online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.64. Original Fujita Scale

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.
Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/f-scale.html		

Table 3.65. Enhanced Fujita Scale

Enhanced Fujita (EF) Scale	Enhanced Fujita Scale Wind Estimate (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200
Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/ef-scale.html	

Interestingly, since implementation of the new scale, Kansas was the location of both the first EF4 (February 28, 2007, Linn County) and EF5 (May 4, 2007, Greensburg) tornadoes.

Location

Figure 3.60 illustrates the number of F3, F4, and F5 tornadoes recorded in the United States per 3,700 square miles between 1950 and 1998. Figure 3.65 illustrates the wind zones in the United States. By noting the Kansas data from these two maps and matching them up in Table 3.66, it appears that all of Kansas is highly susceptible to tornadoes. These maps are the most current to date.

Figure 3.60. Tornado Activity in the United States

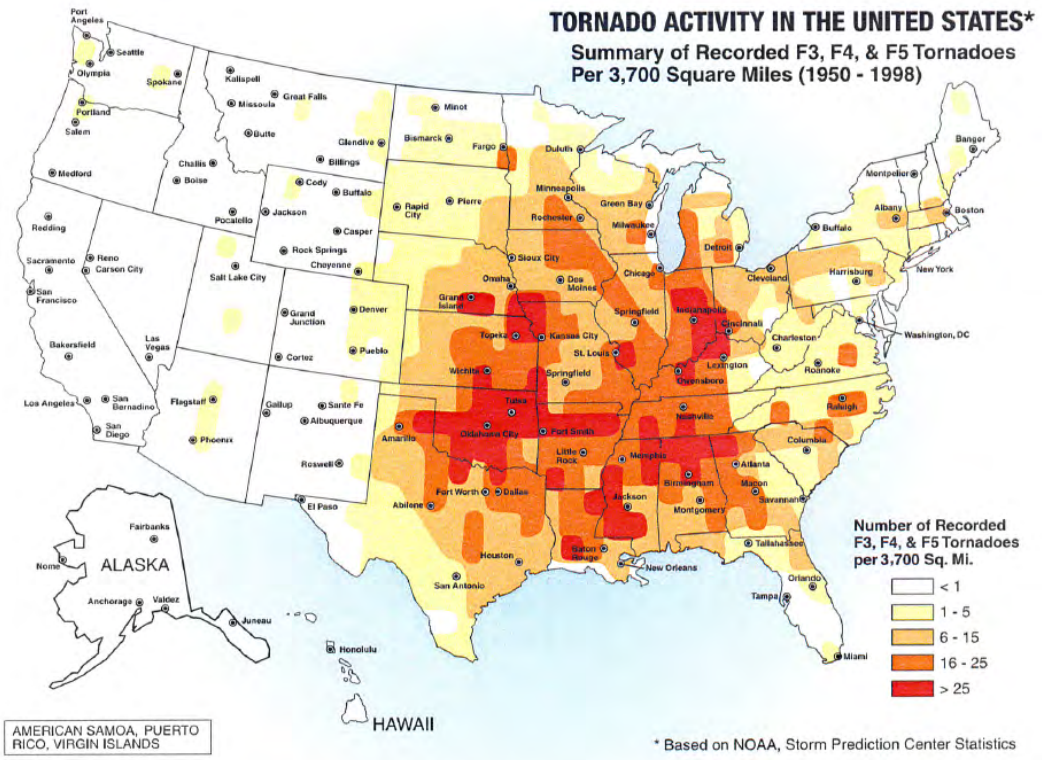


Figure I.1 The number of tornadoes recorded per 3,700 square miles

Source: *Taking Shelter from the Storm*, FEMA, 2004

Figure 3.61. Wind Zones

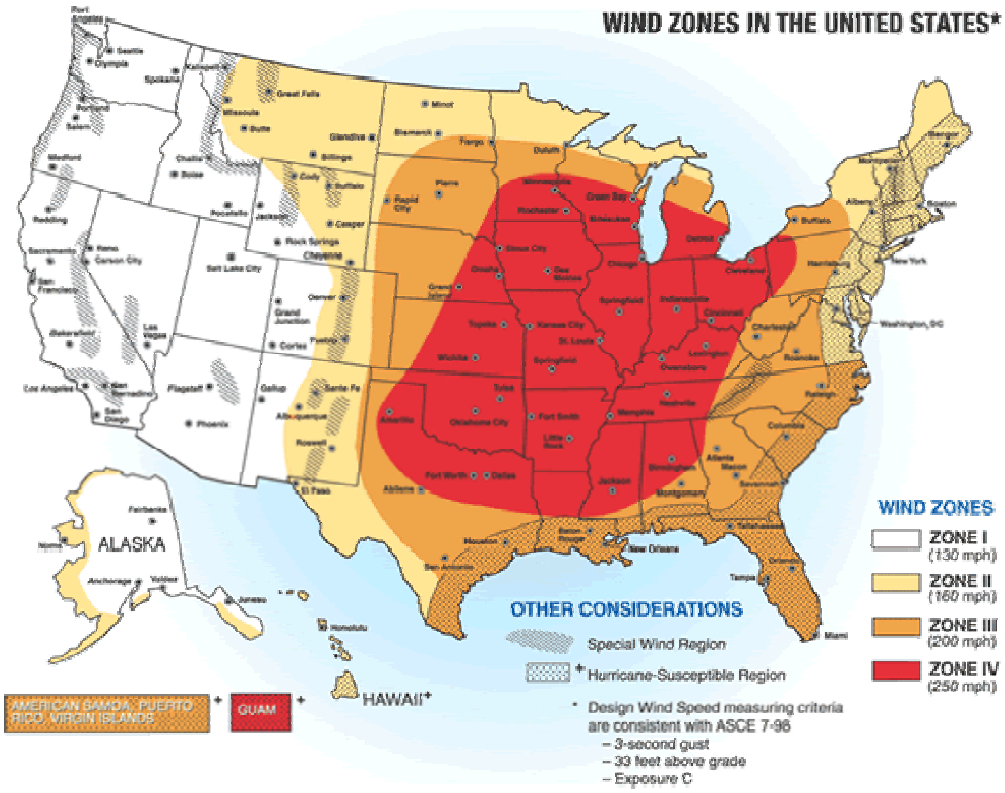


Figure 3.62Spatial Location Map Kansas Tornado Hazard

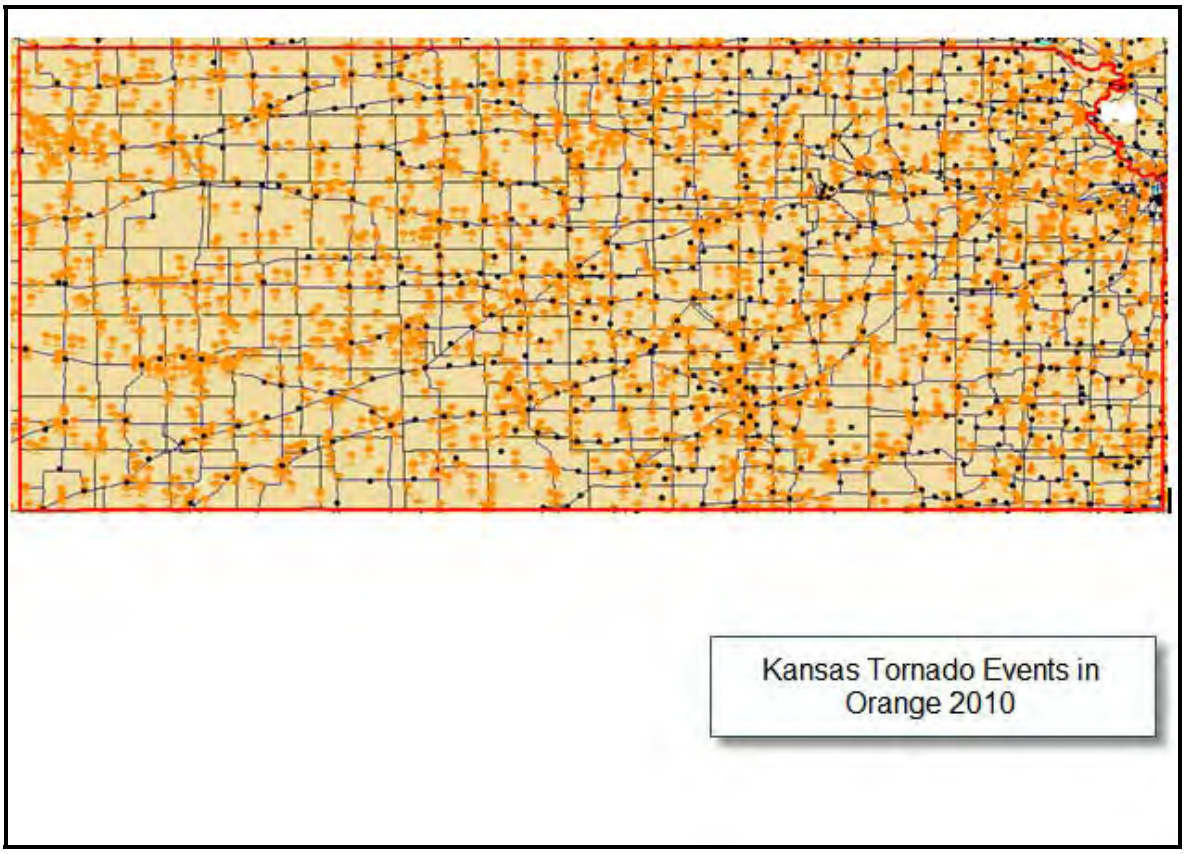


Table 3.66. Wind Zones

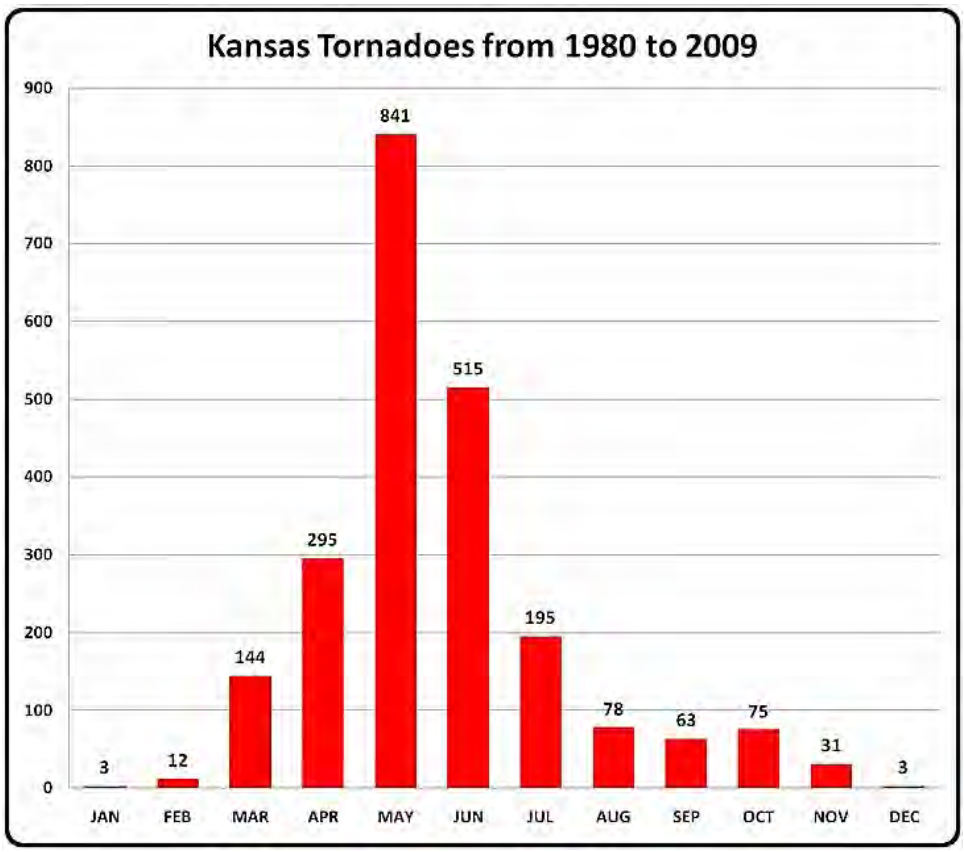
Number of Tornadoes Per 3,700 square miles (See Figure 3.64)	Wind Zone (See Figure 3.65)			
	I	II	III	IV
<1	Low Risk	Low Risk	Low Risk	Moderate Risk
1-5	Low Risk	Moderate Risk	High Risk	High Risk
6-10	Low Risk	Moderate Risk	High Risk	High Risk
11-15	High Risk	High Risk	High Risk	High Risk
>15	High Risk	High Risk	High Risk	High Risk
Source: *Taking Shelter from the Storm*, FEMA, 2004				

More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences

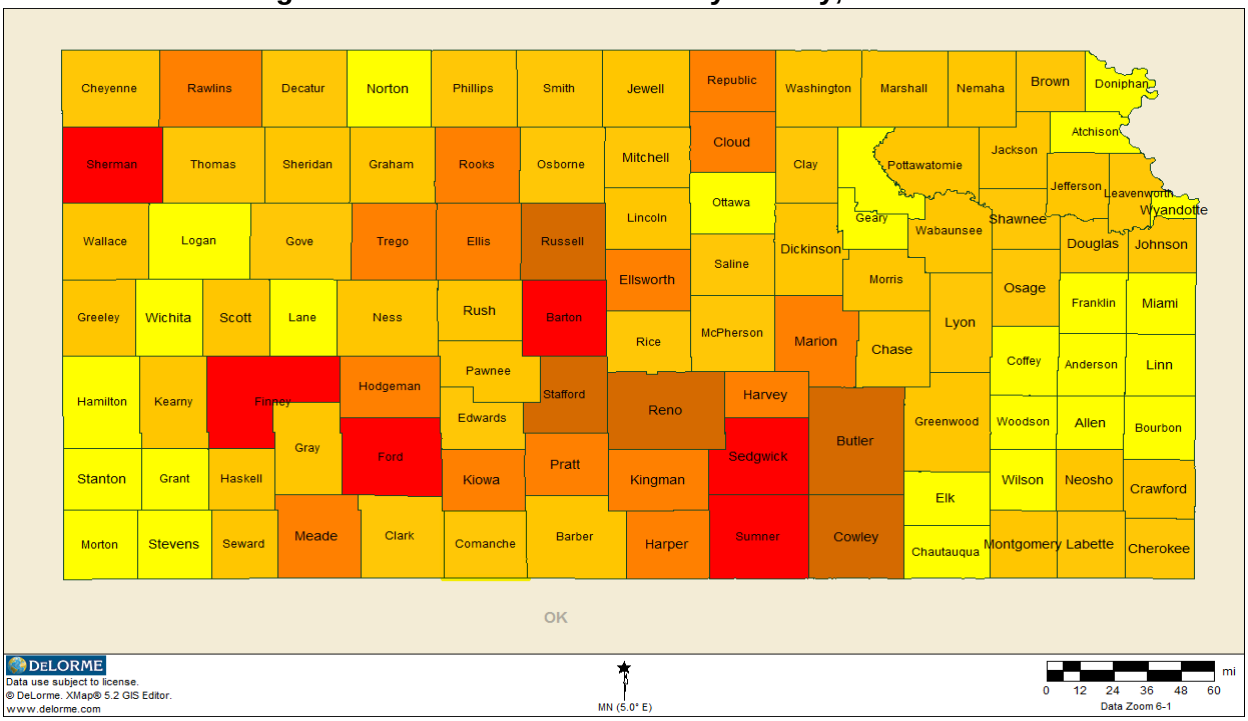
Tornadoes have caused substantial property damage, injury, loss of life, and economic disruption in Kansas. Based on data from the National Climatic Data Center's *2005 Annual Summaries*, Kansas ranks second in the nation for the overall number of tornadoes, third for the number of tornadoes per 10,000 square miles, and eighth for the total number of tornado-caused fatalities.

Tornadoes in Kansas occur most often between March and July, which has come to be known as “tornado season” in Kansas and other areas. The chart below is a breakdown of tornadoes in Kansas by month from 1980 to 2009. The month of May experiences the most tornados.



According to the National Climatic Data Center Storm Events database, there were 3,812 tornadoes in Kansas between 1950 and 2010 (see Figure 3.63). Tornadoes reported in the database are in segments. One tornado can have multiple segments as the database counts a new segment when county boundaries are crossed. So, the number of past occurrences is really a reflection of the number of past tornado segments. Of these events, 17 were rated F5, and 61 were rated F4. Total property and crop damage for these events is estimated at $2.646 billion. There were 233 deaths and 2,714 injuries in this time period. This suggests that Kansas experiences 64 tornadoes, $44 million in tornado losses (property and crop), 4 deaths, and 45 injuries each year. See the section on Vulnerability and Potential Losses by Jurisdiction for more information about how tornadoes affect individual counties. Based on the data collected by the sub-committee it would appear that South Central Kansas is more prone to tornado events with a large majority of this area having between 43 and 90 tornadoes. Of these eight counties (Sedgwick and all adjacent counties) only Sumner County does not currently have a FEMA-approved local mitigation plan. Also it should be noted that of the 17 F5 events recorded in Kansas, 10 were recorded in the South Central area mentioned previously.

Figure 3.63. Kansas Tornadoes by County, 1950–2010



Source: Bold Planning Solutions

- **75 – 90 Events**
- **59 – 74 Events**
- **43 – 58 Events**
- **27 – 42 Events**
- **11 – 26 Events**

FEMA-1849-DR: Severe Storms, Flooding, Straight-line Winds, and Tornadoes – June 25, 2009- On June 11, 2009, Governor Mark Parkinson requested a major disaster declaration because of severe storms accompanied by large hail, lightning, high winds, tornadoes, and torrential rains during the period of April 25 to May 16, 2009. The governor requested a Declaration for Public Assistance for 28 counties and hazard mitigation for all counties. During the period of May 18-22, 2009, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments, and that federal assistance is necessary.

FEMA-1808-DR: Severe Storms, Tornadoes, and Flooding—October 31, 2008- On October 22, 2008, Governor Kathleen Sebelius requested a major disaster declaration because of severe storms accompanied by tornadoes, lightning, and torrential rains resulting in flooding and flash flooding during the period of September 11-18, 2008. The governor requested a Declaration for Public Assistance for 10 counties and hazard mitigation for all counties. During

the period of October 13-17, 2008, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below.

FEMA-1776-DR: Severe Storms, Flooding, and Tornadoes- July 9, 2008 - On June 26, 2008, Governor Kathleen Sebelius requested a major disaster declaration because of severe storms accompanied by large hail, lightening, high winds, tornadoes, and torrential rains during the period of May 22 to June 16, 2008. The governor requested a Declaration for Public Assistance for 49 counties and hazard mitigation for all counties. During the period of June 16-17, 2008, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below.

FEMA-1699-DR: Severe Storms, Tornadoes, and Flooding—May 6, 2007 (May 4)

A 1.7 mile-wide EF5 tornado with wind estimated at 205 mph struck Greensburg in Kiowa County, destroying approximately 90% of the town and severely damaging the remaining 10%. Tornado sirens sounded in the city twenty minutes before the tornado struck, and a tornado emergency was issued, undoubtedly saving many lives in the town of 1,580. Nevertheless, the storm killed 12 people, 10 in Greensburg, one in Pratt, and one in Stafford, and hospitalized 13 others.

Picture of Greenburg, Kansas in Kiowa County, after the devastating EF5 tornado in May of 2007.

Initial assessment results indicated that Greensburg sustained extraordinary losses to housing, business, hospital, schools, and all other public facilities. Electric and water distribution systems were also seriously damaged. The town's entire population was displaced throughout surrounding counties. Farmsteads and farm properties throughout Kiowa County and surrounding areas were also impacted. According to the insurance commissioner, 1,900 insurance claims were filed as of August 14, 2007, totaling approximately $153 million dollars in estimated storm losses in Kiowa County.

FEMA-1638-DR: Severe Storms, Tornadoes, and Straight-Line Winds—April 14, 2006 (March 12-13)

A significant tornado outbreak occurred over portions of eastern Kansas and western Missouri. Damage estimates in the Kansas City metropolitan area alone reached $6.58 million.

FEMA-1462-DR: Severe Storms, Tornadoes, and Flooding—May 6, 2003 (May 4–30)

In two separate storm events, May 4 and 15, tornadoes and flooding occurred across eastern Kansas. There was widespread property damage, seven fatalities, and more than 50 injuries. About a third of the town of Franklin in Crawford County was destroyed.

FEMA-1366-DR: Severe Storms and Tornado—April 27, 2001 (April 21)

On April 21, an F4 tornado touched down in Hoisington in Barton County, damaging many buildings, vehicles, and power and telecommunications systems of the city. There was one fatality and 28 injuries. The storm destroyed 182 homes and caused major damage to 52 homes and minor damage to 180 more residences. A hospital, three schools, and several businesses were damaged. Damage approximated $43 million.

FEMA-1327-DR: Severe Storms and Tornadoes—May 3, 2000 (April 19)

On April 19, damaging tornadoes struck communities in Crawford, Labette, Neosho, and Montgomery Counties. Tornadoes caused extensive damage in Parsons and in Neosho County. An F3 destroyed an area of 30-square blocks, and 30-60-square blocks sustained moderate damage. More than 30 injuries were reported from all the tornadoes combined, most of them in Parsons.

FEMA-1273-DR: Tornadoes and Severe Storms—May 4, 1999 (May 3)
On May 3, severe thunderstorms and as many as four dozen tornadoes swept through south central Kansas, causing 6 deaths and 154 injuries in Haysville and Wichita. Damage exceeded $150 million. Damage summary for Sedgwick County: 8,480 buildings (all types) damaged or destroyed. Of these, 2,456 were at least 50% destroyed and 1,109 totally destroyed. The number of customers that lost power was 52,000.

FEMA-903-DR: Severe Storm, Tornado—April 29, 1991 (April 26)
A tornado touched down in Harper County then skipped across Sedgwick and Butler Counties. In Sedgwick County it grew to F3 intensity and tore through parts of south and east Wichita, making a direct hit on McConnell Air Force Base. Four people were killed in Sedgwick County. The tornado then grew to F5 intensity and went through the community of Andover in Butler County. Major damage was incurred and 13 people were killed. At the same time, another tornado developed in Cowley County that grew to F4 intensity and killed one person east of Winfield and another near Howard in Elk County. Total property damage from these tornadoes was in excess of $272 million.

March 13, 1990
This F5 tornado struck Hesston, killing two people, injuring 60, and damaging or destroying about 226 homes and 21 businesses in the western sections of town. It caused nearly 25 million dollars in damage in Harvey County alone. In Burrton, a six-year-old boy was killed by a crumbling chimney as he huddled in a basement with his family.

June 17, 1978
A tornado struck very near the Whippoorwill Showboat on Lake Pomona in Osage County causing it to capsize, resulting in 16 deaths and 3 injuries among the 58 passengers and crew. Although the deaths were due to drowning, they were attributed to the tornado. Damage was also reported to campers, trees, and power lines, but these were relatively insignificant.

June 8, 1974
This F4 tornado ripped through populated sections on the northwest side of Emporia killing 6 people and injuring 200. It caused massive damage and destruction to a shopping center, mobile home park, nursing home, apartment complex, and residential homes. Ten farmsteads were also damaged. Most of the deaths were in the mobile home park. Property damage in Lyon County was estimated at $25 million.

FEMA-219-DR: Tornadoes, Severe Storms—June 10, 1966 (June 8)
This F5 was the most destructive tornado in Topeka's history. It produced $100 million in damage, which made it the costliest tornado in American history at the time. Although 16 people were killed and 500 injured, excellent public warning and preparedness prevented a much larger number of deaths and injuries. About 820 homes were destroyed and 3,000 damaged as entire blocks were leveled to splinters in seconds. Every building on the Washburn University campus was damaged, many totally destroyed from the violent winds estimated at around 300 mph. The

Capitol Dome sustained damage from tremendous flying debris, as did many downtown Topeka buildings. Power and other utilities were out in much of the community for weeks.

Other tornadoes that day included one in Manhattan that caused 65 injuries, destroyed 11 homes, and damaged 328 others. Losses at Kansas State University alone totaled nearly $2 million. Two other tornadoes struck Leavenworth County, where two injuries and one death were reported.

June 10, 1958
A tornado passed through El Dorado, devastating a section of newer homes in the southwest part of El Dorado. About 200 homes were destroyed as a 45-block area was torn apart. This tornado took the lives of 15 people and injured 50.

FEMA-34-DR: Tornado—May 25, 1955
This F5 tornado killed five children in a home northeast of Oxford before moving on to Udall and completely devastating a large portion of the town. Seventy-five people were killed in Udall, and many of the 270 injuries were serious. Damage in this small town was listed at over 2.2 million. This remains Kansas' deadliest tornado.

May 7, 1927
This tornado ranged from one-half to two miles wide and was on the ground for nearly 100 miles. It traveled from Barber County through Kingman and Reno Counties before dissipating in McPherson County. Ten people were killed and 300 injured.

May 25, 1917
This tornado touched down near Cheney and moved through the southeastern parts of Andale, across the southern edge of Sedgwick to three miles northeast of Florence. Along the path, 118 farms, homes, and businesses were destroyed, many of them completely swept away. Twenty-three people were killed and 70 injured. Twelve of the deaths were in Andale, where half the town was damaged or destroyed. The funnel was reportedly over a mile wide.

November 10, 1995
Two different tornadoes affected portions of central and south-central Kansas on this day. The first one moved across Barton County, causing one million dollars in damage. One hundred and sixty homes were destroyed, and at least 1,000 sheep were killed. Debris was carried 85 miles and hundreds of dead ducks fell from the sky 25 miles northeast of the end of the tornado path. Another tornado moved across portions of Sumner and Sedgwick Counties, destroying at least 10 homes. The total number of deaths for these tornadoes was 15.

Other Notable Tornadoes
- June 15, 2009 - This tornado turned over four pivot irrigation sprinklers and destroyed two 80,000 bushel grain bins in Edwards County. In addition, a 500,000 bushel bin was heavily damaged. One of the 80k bins traveled nearly a mile. There was extensive rear flank downdraft damage in the vicinity of this tornado.
- April 25 2009 - An EF-1 tornado touched down at 1735 CST near the intersection of 238th Street and Loring Street in Leavenworth County. The tornado crossed Interstate 70, and then remained nearly parallel to the interstate, before lifting at 1750 CST, near the intersection of Metro Avenue and 190th Street. Two homes sustained major damage and several barns were destroyed. Numerous trees were uprooted and several outbuildings were damaged.

- June 11 2008 - Two long lived supercells wreaked havoc across portions of north central and northeast Kansas on the night of June 11th. Three significant tornadoes touched down, caused millions of dollars in damage, killed two, and critically injured three citizens. The town of Chapman saw the most extensive damage. Approximately three-quarters of the town was damaged by the tornado that passed through. Numerous homes were demolished, as were both the middle school and high school. One death occurred, as a result of a tree having fallen onto a young woman outside her car, who had just placed her daughter into her car seat. The most severe, but more localized damage occurred in the Miller Ranch neighborhood in Manhattan, where several homes were completely destroyed. A man was killed in his mobile home when it flipped several times and was found a few miles from its original location. The unoccupied home a few hundred feet from the mobile home went virtually untouched. Thousands of citizens turned up over the next few weeks to help with the clean-up effort in both Chapman and Manhattan.
- May 29 2008 - A significant severe weather outbreak occurred during the afternoon and evening of May 29th. Several tornadoes were reported from south of Palco in Rooks County to the community of Jewell in Jewell County. One tornado inflicted significant damage to the community of Jewell, including destroying the town's cafe and water tower. Several homes in rural areas of Mitchell and Jewell Counties were damaged or destroyed. The town of Woodston in eastern Rooks County also had a twister move through the community; luckily damage was not as severe. All together eight tornadoes occurred in this part of north central Kansas and no critical injuries were reported. Other areas of north central Kansas also saw hail and heavy rains from the storms. An area between Webster Lake and Stockton in Rooks County had hail up to the size of baseballs. The hail damaged windows and siding of homes along the storm's path. In addition to the tornadoes, hail and wind, thunderstorms dumped several inches of rain across the Solomon River valleys. This resulted in some flooding of rural roads and area creeks and rivers.
- May 5, 2007—An EF2 tornado in Ottawa County heavily damaged or destroyed numerous homes, cabins, mobile homes, outbuildings, and small cottages. There was one fatality. A second tornado, an EF1, crossed from Ottawa County to Cloud County, destroying a barn and damaging homes, trees, and power poles. Another EF1 near Enosdale damaged a residence, its outbuildings, and several trees and power poles.
- March 28, 2007—Sixteen tornadoes tracked across northwest Kansas and southwest Nebraska. The strongest tornado, an EF2, moved from northeast Sherman County into eastern Cheyenne County, significantly damaging four homes. An EF1 tornado badly damaged three vacant mobile homes in Wallace County. The other storms caused little or no damage.
- February 28, 2007—An EF4 tornado in Linn County destroyed a home north of Blue Mound. Six more homes sustained minor damage, and about a dozen outbuildings were damaged or destroyed; trees and power lines were downed as well. This was the earliest occurrence of a tornado of this magnitude in Kansas.
- October 26, 2006—Twenty-eight tornadoes were reported in southwest Kansas, specifically the counties of Ford, Grant, Clark, Gray, Comanche, and Meade. Only two of the storms caused damage, which was relatively minor.
- August 7, 2006—An F1 tornado in Colby produced minor structural damage to a motel and gas station, damaged vehicles at a car dealership and a number of highway signs, and injured four people.

- April 15, 2006—Five tornadoes struck northeast Kansas. F0s in Brown and Jackson County caused damage to outbuildings, a home, and trees. An F1 destroyed four outbuildings and trees at a farmstead.
- April 6, 2006—An F1 tornado in Labette County damaged two homes and destroyed a mobile home. It caused 12 injuries and an estimated $225,000 in damage. Six tornadoes were also reported in north central Kansas.
- March 30, 2006—A tornado in Montgomery County produced F2 damage, damaging and destroying homes and mobile homes along its 16-mile path. One man was seriously injured. Damage was estimated at $1 million.
- January 28, 2006—The first tornado to strike Kansas in January since reporting began in 1950, this event was also unique in that it was not associated with a thunderstorm. Fifty cars at a car lot were damaged by this F0 tornado.
- November 27, 2005—Occurring unusually late in the year, a number of F0 and F1 touched down across east-central and southeast Kansas. The strongest tornado, an F1 in Neosho County, caused an estimated $120,000 in damage to homes and outbuildings. There were no deaths or injuries. In terms of the number of reported tornadoes, this was the largest November outbreak in the Wichita forecast area since reporting began in 1950.
- August 19, 2005—A tornado caused an estimated $500,000 damage to Great Bend Airport where hangars were unroofed and an unspecified number of aircraft were overturned. A second touchdown in the Great Bend area caused $250,000 in damage to two farmsteads.
- June 9, 2005—An F1 tornado in Rooks County damaged a historic theater and a farm, toppled a grain silo, mangled a power station, and downed power lines.
- June 4, 2005—An F2 tornado damaged or destroyed 15 buildings in Brown County. An F1 damaged trees and four buildings and downed power lines in Pottawatomie County.
- April 21, 2005—An F3 tornado in Neosho County destroyed two mobile homes, two barns, two out-buildings, one garage, one shed; unroofed one home; and dislodged one home from its foundation, ultimately causing an estimated $200,000 in damage.
- August 27, 2004—Three tornadoes hit Sumner and Cowley Counties. The most significant of the three, an F2, damaged two homes and snapped four utility poles.
- July 7, 2004—A mini-outbreak of short-lived twisters struck Russell County. An F1 tornado did $100,000 in damage to two homes.
- June 12, 2004—Sumner and Cowley Counties experienced five tornadoes. An F3 caused $575,000 in damage to property and crops. Two people were injured.
- May 29, 2004—Five tornadoes were reported in Harper County. An F2 caused $375,000 in damage to property and crops. One F3 storm destroyed 15 farm buildings, 25 pieces of farm equipment, many miles of transmission line, and crops. Damage was estimated at nearly $2 million. A second F3 caused $1 million damage, which was largely to two homesteads.
- May 12, 2004—Sixteen tornadoes were reported in Harper County. An F4 storm destroyed a farm house, five barns, and five cars with damage to property and crops approximating $350,000. Three F2 tornadoes caused an additional $380,000 in damage.
- May 8, 2003—Nine tornadoes struck the Topeka National Weather Service County Warning Area. Four injuries were reported. In Anderson County, an F2 tornado injured three people, destroyed seven homes, and damaged several others. In Douglas County, three tornadoes were confirmed, an F0, F1, and F2. The F2 caused one injury and damaged 40 structures. Two tornadoes were confirmed in Osage County, an F1 and an F3. The F3 produced extensive damage. The same day in the Wichita area, an F3 in Woodson County destroyed several barns and a few houses. Trees were stripped bare or just blown away, and some cars were rolled. Another tornado did substantial damage in Anderson and Linn Counties.

- May 4, 2003—Tornadoes in southern Kansas caused tree damage and downed power lines. Structural damage to homes was reported in Labette County.
- September 2001—Tornadoes hit in central Kansas, destroying at least two homes, damaging several others, and interrupting utilities in Saline County.
- June 2001—Two tornadoes caused damage in Republic County.
- May 7, 1993—A tornado killed one person in Russell County.
- June 15, 1992—This day set Kansas' record for the most tornadoes on one day: 39.

Local Plan Integration

For the 2010 update the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.67.

Table 3.67.Local Plan Statistics for Tornado Events

County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	High	24	$5,553,000.00	N/A	4	0
Brown	Moderate	38	$5,481,000.00	N/A	5	0
Butler	High	59	$254,216,000.00	N/A	170	28
Chase	Moderate	30	$5,350,000.00	N/A	2	0
Cherokee	High	36	$3,107,000.00	N/A	N/A	N/A
Cloud	High	44	$34,103,000.00	N/A	N/A	N/A
Cowley	High	59	$39,716,000.00	N/A	290	77
Crawford	High	34	$39,778,000.00	$100,000.00	43	4
Dickinson	Moderate	32	$26,200,000.00	$48,248.00	9	1
Douglas	High	31	$39,025,000.00	$90,000.00	47	1
Elk	Moderate	17	$3,000,000.00	N/A	8	2
Ellsworth	High	43	$5,916,000.00	N/A	N/A	N/A
Harper	High	53	$3,265,000.00	$425,000.00	1	N/A
Harvey	High	46	$53,986,000.00	N/A	62	1
Jewell	High	33	$8,912,000.00	$1,100,000.00	1	N/A
Johnson	Moderate	31	$7,370,000.00	N/A	12	4
Kingman	High	43	$396,000.00	N/A	1	N/A
Kiowa	High	44	$251,103,000.00	N/A	74	11
Labette	High	31	$79,000,000.00	N/A	41	1
Linn	Moderate	12	$1,338,000.00	N/A	3	N/A
Lyon	High	36	$50,911,000.00	$20,000.00	3	N/A
Marion	High	45	$20,000,000.00	N/A	10	5
Meade	High	44	N/A	N/A	0	0
Miami	Moderate	16	$6,300,000.00	N/A	29	4
Mitchell	Moderate	40	$6,303,250.00	N/A	5	N/A
Montgomery	High	30	$4,000,000.00	N/A	2	1
Neosho	High	28	$3,553,000.00	N/A	4	N/A
Norton	High	18	$1,290,000.00	N/A	N/A	N/A
Osage	High	36	$28,769,000.00	N/A	204	23
Pratt	Moderate	54	$21,366,000.00	$150,000.00	5	1
Reno	High	67	$60,000,000.00	N/A	17	N/A
Rush	Moderate	29	$591,000.00	N/A	8	0
Scott	Moderate	34	$3,200,000.00	N/A	1	1
Sedgwick	High	75	$430,000,000.00	N/A	303	13
Shawnee	High	38	$283,000,000.00	N/A	607	18

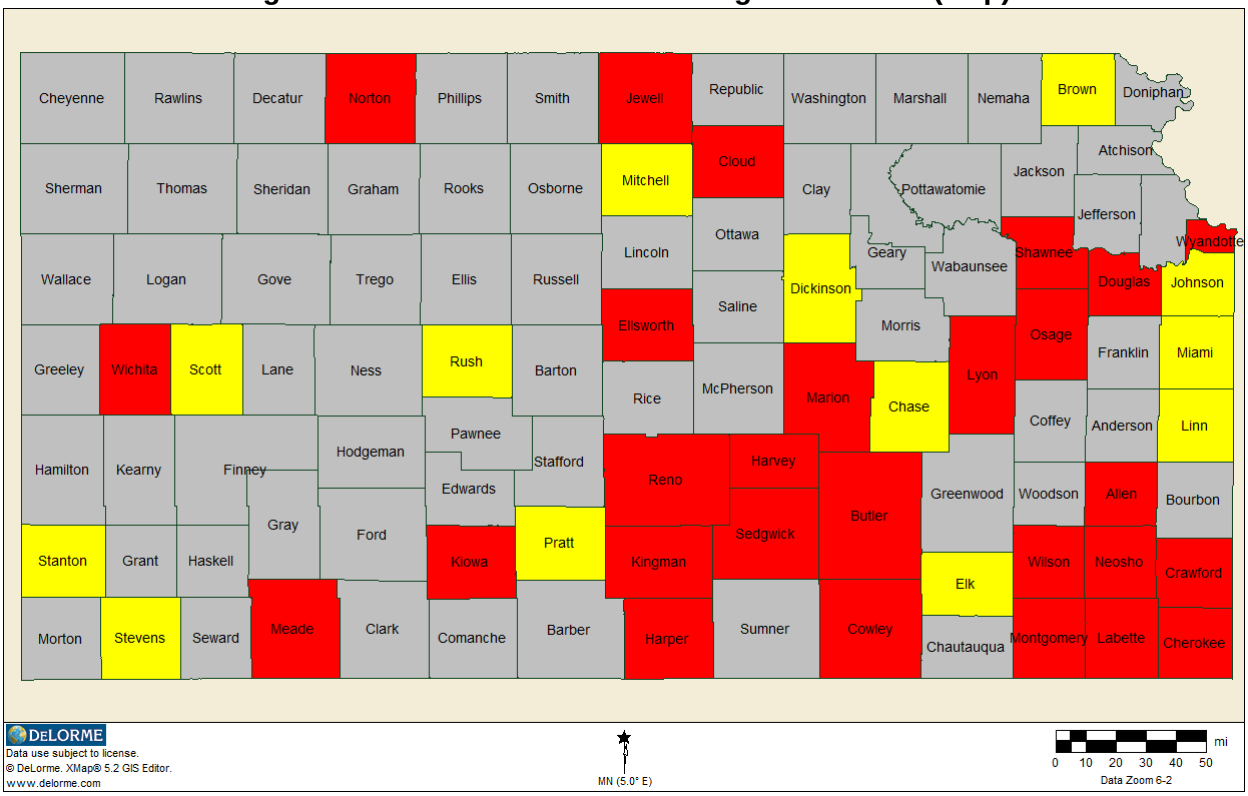
County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Stanton	Moderate	19	$353,000.00	N/A	0	0
Stevens	Moderate	25	$9,216,000.00	N/A	5	1
Wichita	High	25	$400,000.00	N/A	4	0
Wilson	High	11	$545,000.00	N/A	12	3
Wyandotte	High	11	$23,000,000.00	N/A	42	N/A
Totals		**1421**	**$1,819,612,250.00**	**$1,933,248.00**	**2034**	**200**

After reviewing the data from the local plans throughout the State of Kansas, the committee calculated averages for tornadoes, as shown in the table located below. The state can expect an average of roughly one injury and $1,281,875 in damages from a single tornado event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate. Included is a map illustrating each planning area's personal risk rating for this hazard.

Table 3.68.Local Plan Averages for Tornado Events

	Deaths	Injuries	Total Damages
Totals	200	2034	$1,821,545,498
Average per County	5	50.85	$45,538,637
Average Per Event	0.14	1.43	$1,281,875

Figure 3.64.Local Plan Hazard Rating for Tornado (Map)



Source: Bold Planning Solutions

Red – High Risk – 27 Jurisdictions

Yellow – Moderate Risk – 13 Jurisdictions

Gray – No Plan or Rating – 65 Jurisdictions

Probability

According to the National Climatic Data Center, there were 3,812 tornadoes in Kansas between 1950 and 2010 (60 years). Based on this information, the probability that at least one tornado will occur in Kansas in any given year is 100%. The estimated annualized loss for property and crops is $142 million. This hazard's CPRI probability is "**Highly Likely**" within the calendar year.

Vulnerability and Potential Losses by Jurisdiction

Methodology

All 105 counties in Kansas are vulnerable to tornadoes. To refine and assess the relative vulnerability of each of Kansas' counties to tornadoes, the state assigned ratings to four factors that were examined at the county level: prior events, building exposure, population density, and past tornado damage. The state then summed the ratings to obtain overall vulnerability scores for each county so that they could be compared and the greatest vulnerability determined. The factors are described below.

Vulnerability Factors

Prior Events—This rating is based on the number of past tornadoes experienced by each county between 1950 and 2010 according to data from the National Climatic Data Center's Storm Events database (a compilation of storm data from the National Weather Service). Tornadoes reported in the database are in segments. So, the number of past occurrences is really a reflection of the number of past tornado segments. The word "tornado" going forward refers to tornado segments. To develop the prior event rating, the total range of past occurrences (11 to 90) was divided into 10 equal ranges as shown in Table 3.69. The ranges were numbered 1 through 10 in ascending order.

Table 3.69. Prior Event Ratings

# of Past Occurrences	Rating
11 – 18	1
19 – 26	2
27 – 34	3
35 – 42	4
43 – 50	5
51 – 58	6
59 – 66	7
67 – 74	8
75 – 82	9
83 – 90	10

Building Exposure—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

Population Density—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

Past Tornado Damage—This rating is based on the property damage for the tornadoes that occurred in Kansas between 1950 and 2010 as reported in the National Climatic Data Center's Storm Events database. This damage was presented in actual values for the year the events occurred. The state received $6,911,215 billion in tornado damage between 1950 and 2010, which averages out to approximately $115,186,916 million per year.

Past tornado damage was divided into 10 equal ranges as shown in Table 3.70. The ranges were numbered 1 through 10 in ascending order.

Table 3.70. Past Tornado Damage Ratings

Past Tornado Damage ($)	Rating
50,000 – 42,995,000	1
42,995,001 – 85,990,000	2
85,990,001 – 128,985,000	3

128,985,001 – 171,980,000	4
171,980,001 – 214,975,000	5
214,975,001 – 257,970,000	6
257,970,001 – 300,965,000	7
300,965,001 – 343,960,000	8
343,960,001 – 386,955,000	9
386,955,001 – 430,000,000	10

After rating each of the counties on the factors described above, the four factor ratings were added together to produce a county-level vulnerability rating. The highest possible total vulnerability rating was 40. The total range of vulnerability (4 to 32) was divided into three equal ranges as shown in Table 3.71. The ranges were assigned a corresponding level of tornado vulnerability: moderate, high, and very high. The vulnerability scale begins at moderate as every county has some degree of vulnerability.

Table 3.71. Tornado Vulnerability

Tornado Vulnerability Range	Tornado Vulnerability
4 – 13	Moderate
14 – 23	High
24 - 32	Very High

Results

Vulnerability Factors

Summary of Prior Event Ratings—The lowest number of recorded tornadoes over this 60-year period was 11 in Wyandotte County; the highest was 90 in Sherman County. All counties in Kansas experienced at least 10 tornadoes in the past 60 years. Eleven percent of the counties received ratings of 1, 16% received ratings of 2, 28% received ratings of 3, 19% received ratings of 4, and 11% received ratings of 5. The counties that received a prior event rating greater than 5 are shown in Table 3.72.

Table 3.72. Counties with Prior Event Ratings Greater Than 5

County	# of Prior Events	Prior Event Rating
Sherman	90	10
Barton	82	9
Finney	80	9
Ford	79	9
Sedgwick	75	9
Sumner	75	9
Butler	71	8
Reno	67	8
Pratt	65	7
Russell	60	7
Cowley	59	7
Republic	56	6
Harper	55	6

A spreadsheet that includes the corresponding values can be found in Appendix H Kansas Tornado Vulnerability.

Summary of Building Exposure Event Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

A spreadsheet that includes the corresponding values can be found in Appendix H Kansas Tornado Vulnerability.

Summary of Population Density Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

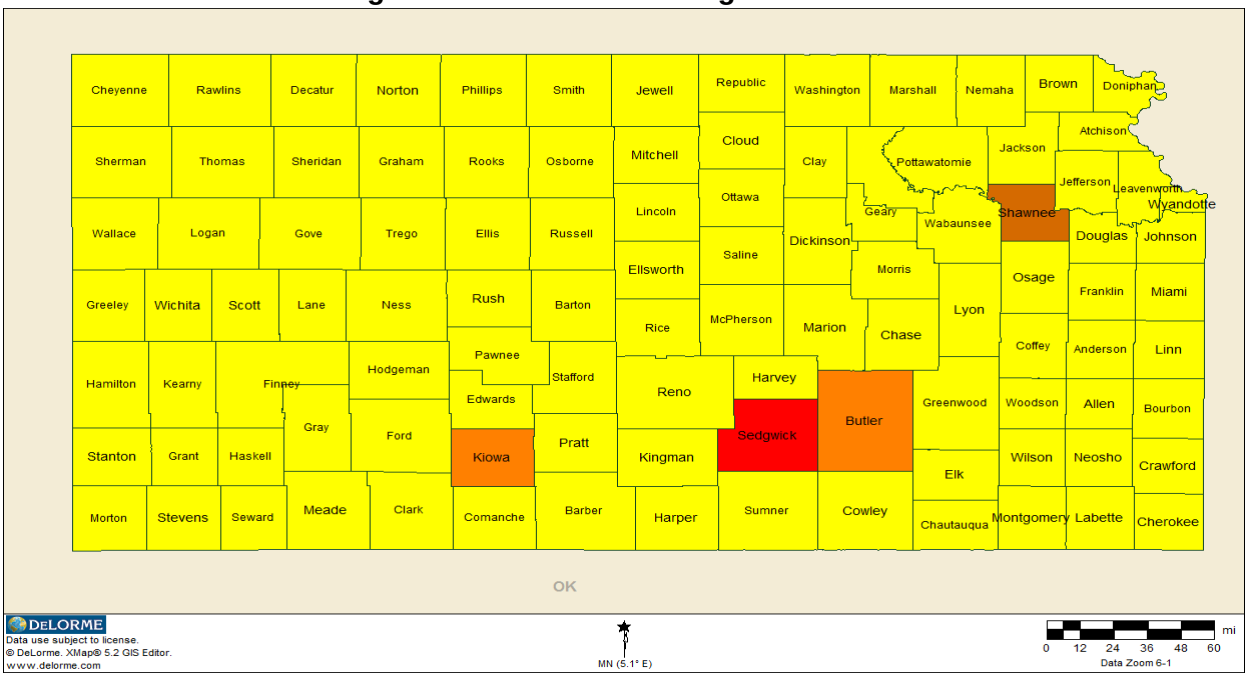
A spreadsheet that includes the corresponding values can be found in Appendix H Kansas Tornado Vulnerability.

Summary of Past Tornado Damage Ratings—During the 60-year period, Sedgwick County incurred the most tornado damage: $430,000,000. Logan County incurred the least: $50,000. Sedgwick County, with $430,000,000 in damage, received a rating of 10. Ninety-two percent of the counties received a rating of 1. Those counties that received a rating higher than 1 are listed in Table 3.73. Figure 3.68 shows the distribution of tornado damage across the state between 1950 and 2010.

Table 3.73. Counties with Past Tornado Damage Ratings Greater Than 1

County	Past Tornado Damage ($)	Past Tornado Damage Rating
Sedgwick	430,000,000	10
Shawnee	283,000,000	7
Butler	254,216,000	6
Kiowa	251,103,000	6
McPherson	83,564,000	2
Labette	79,000,000	2
Reno	60,000,000	2
Harvey	53,986,000	2
Clay	53,556,000	2
Saline	53,238,000	2
Lyon	50,911,000	2
Ottawa	50,631,000	2
Barton	49,380,000	2

Figure 3.65. Tornado Damage 1950–2010



Source: Bold Planning Solutions

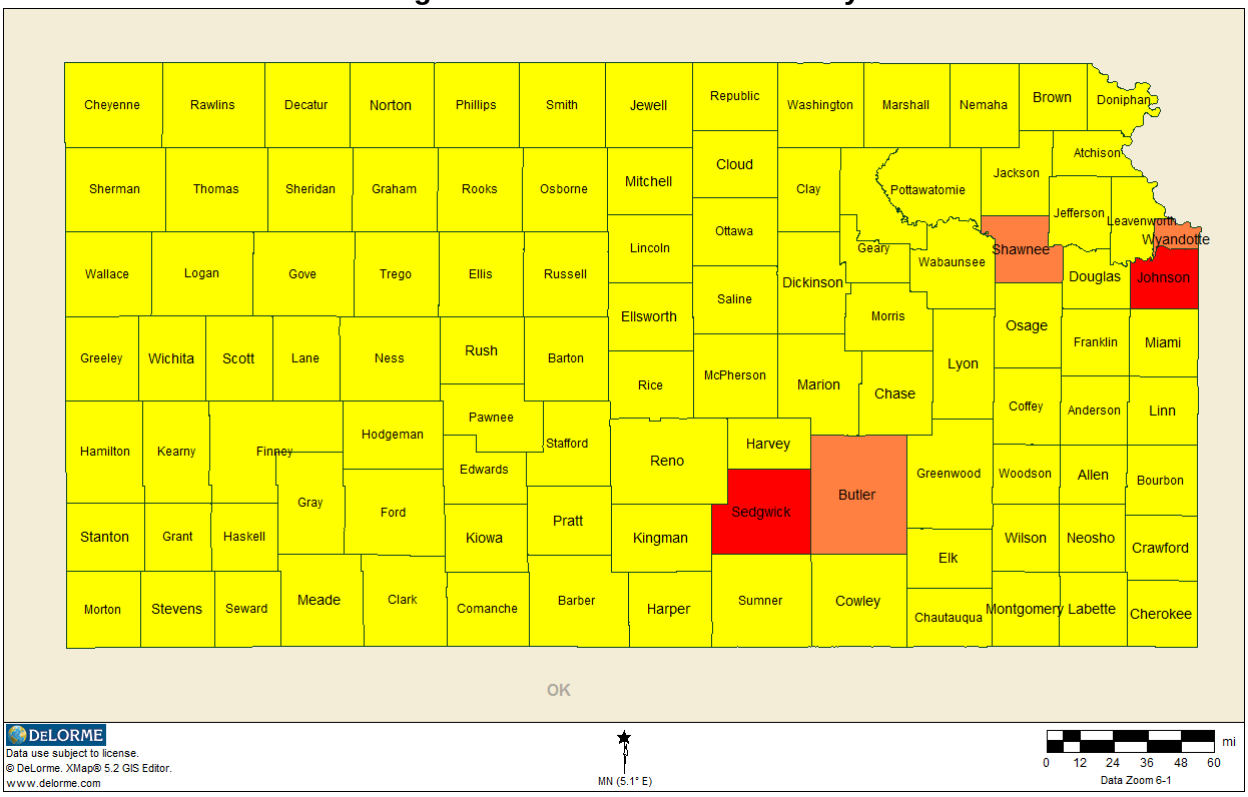
- **$343,960,001 – $430,000,000**
- **$257,970,001 – $343,960,000**
- **$171,980,001 - $257,970,000**
- **$85,990,001 – $171,980,000**
- **$50,000 – $85,990,000**

A spreadsheet that includes the corresponding values can be found in Appendix H Kansas Tornado Vulnerability.

Total Tornado Vulnerability and Estimate of Potential Loss

According to this methodology, while every Kansas county is vulnerable to tornadoes, only Sedgwick and Johnson have very high vulnerabilities. Shawnee and Butler Counties have high vulnerabilities. The remainder of the counties, 94%, has moderate vulnerabilities. Figure 3.69 illustrates the vulnerability of Kansas counties to tornadoes, and Table 3.74 shows all the Kansas counties ranked by total tornado vulnerability along with their four vulnerability factor ratings.

Figure 3.66. Tornado Vulnerability



Source: Bold Planning Solutions

- **Very High Vulnerability**
- **High Vulnerability**
- **Moderate Vulnerability**

Table 3.74. Vulnerability of Kansas Counties to Tornadoes (ranked by vulnerability)

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Past Tornado Damage Rating	Total Tornado Rating	Tornado Vulnerability
Sedgwick	9	8	5	10	32	Very High
Johnson	3	10	10	1	27	Very High
Shawnee	4	3	3	7	17	High
Butler	7	1	1	6	15	High
Wyandotte	1	3	10	1	15	High
Barton	9	1	1	2	13	Moderate
Finney	9	1	1	1	13	Moderate
Kiowa	5	1	1	6	13	Moderate
Sherman	10	1	1	1	13	Moderate
Ford	9	1	1	1	12	Moderate
Reno	8	1	1	2	12	Moderate
Sumner	9	1	1	1	12	Moderate
Cowley	7	1	1	1	10	Moderate

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Past Tornado Damage Rating	Total Tornado Rating	Tornado Vulnerability
Russell	7	1	1	1	10	Moderate
Stafford	7	1	1	1	10	Moderate
Douglas	3	2	3	1	9	Moderate
Ellis	6	1	1	1	9	Moderate
Harper	6	1	1	1	9	Moderate
Harvey	5	1	1	2	9	Moderate
Pratt	6	1	1	1	9	Moderate
Republic	6	1	1	1	9	Moderate
Trego	6	1	1	1	9	Moderate
Cloud	5	1	1	1	8	Moderate
Ellsworth	5	1	1	1	8	Moderate
Hodgeman	5	1	1	1	8	Moderate
Kingman	5	1	1	1	8	Moderate
Leavenworth	3	2	2	1	8	Moderate
Lyon	4	1	1	2	8	Moderate
Marion	5	1	1	1	8	Moderate
McPherson	4	1	1	2	8	Moderate
Meade	5	1	1	1	8	Moderate
Rawlins	5	1	1	1	8	Moderate
Rooks	5	1	1	1	8	Moderate
Brown	4	1	1	1	7	Moderate
Cherokee	4	1	1	1	7	Moderate
Cheyenne	4	1	1	1	7	Moderate
Clark	4	1	1	1	7	Moderate
Clay	3	1	1	2	7	Moderate
Comanche	4	1	1	1	7	Moderate
Decatur	4	1	1	1	7	Moderate
Edwards	4	1	1	1	7	Moderate
Gove	4	1	1	1	7	Moderate
Labette	3	1	1	2	7	Moderate
Mitchell	4	1	1	1	7	Moderate
Osage	4	1	1	1	7	Moderate
Osborne	4	1	1	1	7	Moderate
Phillips	4	1	1	1	7	Moderate
Rice	4	1	1	1	7	Moderate
Saline	3	1	1	2	7	Moderate
Smith	4	1	1	1	7	Moderate
Thomas	4	1	1	1	7	Moderate
Wabaunsee	3	1	1	2	7	Moderate
Barber	3	1	1	1	6	Moderate
Chase	3	1	1	1	6	Moderate
Crawford	3	1	1	1	6	Moderate
Dickinson	3	1	1	1	6	Moderate
Graham	3	1	1	1	6	Moderate
Gray	3	1	1	1	6	Moderate
Greeley	3	1	1	1	6	Moderate

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Past Tornado Damage Rating	Total Tornado Rating	Tornado Vulnerability
Greenwood	3	1	1	1	6	Moderate
Haskell	3	1	1	1	6	Moderate
Jackson	3	1	1	1	6	Moderate
Jefferson	3	1	1	1	6	Moderate
Jewell	3	1	1	1	6	Moderate
Kearny	3	1	1	1	6	Moderate
Lincoln	3	1	1	1	6	Moderate
Marshall	3	1	1	1	6	Moderate
Montgomery	3	1	1	1	6	Moderate
Morris	3	1	1	1	6	Moderate
Nemaha	3	1	1	1	6	Moderate
Neosho	3	1	1	1	6	Moderate
Ness	3	1	1	1	6	Moderate
Ottawa	2	1	1	2	6	Moderate
Pawnee	3	1	1	1	6	Moderate
Pottawatomie	3	1	1	1	6	Moderate
Rush	3	1	1	1	6	Moderate
Scott	3	1	1	1	6	Moderate
Seward	3	1	1	1	6	Moderate
Sheridan	3	1	1	1	6	Moderate
Wallace	3	1	1	1	6	Moderate
Washington	3	1	1	1	6	Moderate
Allen	2	1	1	1	5	Moderate
Atchison	2	1	1	1	5	Moderate
Coffey	2	1	1	1	5	Moderate
Franklin	2	1	1	1	5	Moderate
Grant	2	1	1	1	5	Moderate
Hamilton	2	1	1	1	5	Moderate
Lane	2	1	1	1	5	Moderate
Logan	2	1	1	1	5	Moderate
Riley	2	1	1	1	5	Moderate
Stanton	2	1	1	1	5	Moderate
Stevens	2	1	1	1	5	Moderate
Wichita	2	1	1	1	5	Moderate
Anderson	1	1	1	1	4	Moderate
Bourbon	1	1	1	1	4	Moderate
Chautauqua	1	1	1	1	4	Moderate
Doniphan	1	1	1	1	4	Moderate
Elk	1	1	1	1	4	Moderate
Geary	1	1	1	1	4	Moderate
Linn	1	1	1	1	4	Moderate
Miami	1	1	1	1	4	Moderate
Morton	1	1	1	1	4	Moderate
Norton	1	1	1	1	4	Moderate
Wilson	1	1	1	1	4	Moderate
Woodson	1	1	1	1	4	Moderate

To estimate potential losses to tornadoes, historic loss data was analyzed. According to the data gathered, there were 3,910 tornado segments in Kansas between 1950 and 2010. Total property and crop damage for these events is estimated at $6.911 billion in 2010 dollars. There were 214 deaths and 2,617 injuries in this time period. This suggests that Kansas experiences 65 tornadoes, $115,186,916 million in tornado losses (property and crop), 4 deaths, and 46 injuries each year. The total historic losses and annualized losses by county are presented in Table 3.75, data for the areas with FEMA approved local plans can be found in the Local Plan Integration section.

Table 3.75. Annualized Losses from Tornadoes (1950–2010)

County	# of Events	Property Damage ($)	Annual Property Damages ($)	Crop Damage ($)	Annual Crop Damages ($)
Anderson	14	$4,403,000.00	$73,383.33	$0.00	$0.00
Atchison	21	$26,728,000.00	$445,466.67	$50,000.00	$833.33
Barber	32	$588,000.00	$9,800.00	$0.00	$0.00
Barton	82	$49,380,000.00	$823,000.00	$10,000.00	$166.67
Bourbon	15	$680,000.00	$11,333.33	$0.00	$0.00
Chatauqua	15	$313,000.00	$5,216.67	$0.00	$0.00
Cheyenne	36	$7,665,000.00	$127,750.00	$250,000.00	$4,166.67
Clark	36	$75,000.00	$1,250.00	$0.00	$0.00
Clay	34	$53,556,000.00	$892,600.00	$0.00	$0.00
Coffey	22	$3,160,000.00	$52,666.67	$0.00	$0.00
Comanche	36	$285,000.00	$4,750.00	$0.00	$0.00
Decatur	39	$8,330,000.00	$138,833.33	$0.00	$0.00
Doniphan	16	$26,078,000.00	$434,633.33	$0.00	$0.00
Edwards	37	$4,505,000.00	$75,083.33	$50,000.00	$833.33
Ellis	51	$5,128,000.00	$85,466.67	$0.00	$0.00
Finney	80	$31,511,000.00	$525,183.33	$0.00	$0.00
Ford	79	$2,753,000.00	$45,883.33	$0.00	$0.00
Franklin	24	$3,016,000.00	$50,266.67	$0.00	$0.00
Geary	16	$3,264,000.00	$54,400.00	$0.00	$0.00
Gove	37	$3,978,000.00	$66,300.00	$0.00	$0.00
Graham	32	$2,922,000.00	$48,700.00	$0.00	$0.00
Grant	24	$5,760,000.00	$96,000.00	$0.00	$0.00
Gray	30	$4,681,000.00	$78,016.67	$150,000.00	$2,500.00
Greeley	29	$78,000.00	$1,300.00	$0.00	$0.00
Greenwood	33	$9,271,000.00	$154,516.67	$0.00	$0.00
Hamilton	22	$560,000.00	$9,333.33	$0.00	$0.00
Haskell	31	$8,718,000.00	$145,300.00	$0.00	$0.00
Hodgeman	44	$1,021,000.00	$17,016.67	$0.00	$0.00
Jackson	27	$7,255,000.00	$120,916.67	$55,000.00	$916.67
Jefferson	34	$28,845,000.00	$480,750.00	$2,000.00	$33.33
Kearny	28	$578,000.00	$9,633.33	$0.00	$0.00

Lane	25	$158,000.00	$2,633.33	$0.00	$0.00
Leavenworth	30	$13,640,000.00	$227,333.33	$0.00	$0.00
Lincoln	27	$788,000.00	$13,133.33	$5,000.00	$83.33
Logan	22	$50,000.00	$833.33	$0.00	$0.00
Marshall	31	$26,479,000.00	$441,316.67	$0.00	$0.00
McPherson	41	$83,564,000.00	$1,392,733.33	$0.00	$0.00
Morris	28	$6,570,000.00	$109,500.00	$3,000.00	$50.00
Morton	18	$2,683,000.00	$44,716.67	$0.00	$0.00
Nemaha	31	$9,555,000.00	$159,250.00	$75,000.00	$1,250.00
Ness	34	$3,960,000.00	$66,000.00	$0.00	$0.00
Osborne	40	$4,980,000.00	$83,000.00	$250,000.00	$4,166.67
Ottawa	20	$50,631,000.00	$843,850.00	$5,000.00	$83.33
Pawnee	34	$1,935,000.00	$32,250.00	$0.00	$0.00
Phillips	36	$5,903,000.00	$98,383.33	$0.00	$0.00
Pottawatomie	28	$2,333,000.00	$38,883.33	$55,000.00	$916.67
Rawlins	44	$790,000.00	$13,166.67	$0.00	$0.00
Republic	56	$10,854,000.00	$180,900.00	$100,000.00	$1,666.67
Rice	35	$25,995,000.00	$433,250.00	$5,000.00	$83.33
Riley	22	$3,468,000.00	$57,800.00	$0.00	$0.00
Rooks	48	$15,508,000.00	$258,466.67	$500,000.00	$8,333.33
Russell	59	$5,933,000.00	$98,883.33	$510,000.00	$8,500.00
Saline	32	$53,238,000.00	$887,300.00	$0.00	$0.00
Seward	33	$15,662,000.00	$261,033.33	$140,000.00	$2,333.33
Sheridan	29	$4,820,000.00	$80,333.33	$350,000.00	$5,833.33
Sherman	90	$6,256,000.00	$104,266.67	$0.00	$0.00
Smith	36	$10,954,000.00	$182,566.67	$111,000.00	$1,850.00
Stafford	62	$1,725,000.00	$28,750.00	$0.00	$0.00
Sumner	75	$28,008,000.00	$466,800.00	$325,000.00	$5,416.67
Thomas	42	$1,509,000.00	$25,150.00	$3,510,000.00	$58,500.00
Trego	55	$8,843,000.00	$147,383.33	$0.00	$0.00
Wabaunsee	30	$29,398,000.00	$489,966.67	$53,000.00	$883.33
Wallace	33	$307,000.00	$5,116.67	$0.00	$0.00
Washington	28	$27,001,000.00	$450,016.67	$40,000.00	$666.67
Woodson	12	$5,525,000.00	$92,083.33	$261,000.00	$4,350.00

Development in Hazard-Prone Areas

New development anywhere in Kansas will be susceptible to tornado impacts. New manufactured housing development will be most susceptible to damage, particularly if not anchored properly. The extent of new manufactured housing development is not known.

3.3.19 Utility/Infrastructure Failure

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
2.85	10 of 22	Moderate

Description

Critical infrastructure involves several different types of facilities and systems: transportation, power systems, natural gas and oil pipelines, water and sewer systems, storage networks, and telecommunications facilities. State and locally designated critical facilities, such as hospitals, government centers, etc., are also considered critical infrastructure. Failure of utilities or other components of the infrastructure in Kansas can seriously impact public health, the functioning of communities, and the state's economy. Disruption of any of these services could result from the majority of the natural, technological, and manmade hazards described in this plan (water systems are particularly vulnerable to drought).

Also of concern are solar storms. The next 11-year cycle of solar storms will most likely start in March 2008 and peak in late 2011 or mid-2012. These storms can potentially affect power and communication systems.

The largest electric utilities in Kansas are Kansas Gas and Electric, Westar Energy, Kansas City Power and Light Company, Board of Public Utilities and Utilicorp United, Inc. Two nuclear power plants serve Kansas: Cooper Nuclear Station in Brownville, Nebraska, and Wolf Creek in Burlington, Kansas. However, the state gets power from a large number of suppliers. There are 121 municipal electric utilities that provide electricity to approximately 18% of the state's consumers. Generally, these smaller electrical suppliers have limited resources for mitigation. Thus, the large number of electric service providers could mean greater vulnerability of the state in the event of a major, widespread disaster, such as a severe winter storm or ice storm. The majority of the municipal utilities purchase power on the wholesale market for resale to their customers. This may make them more vulnerable to regional shortages of power as well. Such vulnerability was demonstrated in the power outages in the Great Lakes and New York area in 2003.

In recent years, regional electric power grid system failures in the western and northeastern United States have demonstrated that similar failures could happen in Kansas. This vulnerability is most appropriately addressed on a multi-state regional or national basis. Another recent concern of the state that could affect the functioning of utilities and infrastructure is cybersecurity.

Location

While every community in the state is susceptible to this hazard, the risk posed by utility or infrastructure failure is generally low to moderate for the state. The risk is somewhat elevated in the northeast area of the state because of the greater population density, development, and economic activities of the Kansas City metropolitan area. The next highest region of risk from this hazard is the south-central portion of the state because of the population density, development, and economic activity in the Wichita area.

Figures 3.67 and 3.68 illustrate the location of electric transmission lines and electric plants, substations, and power plants in Kansas.

Figure 3.67. Electric Transmission Lines

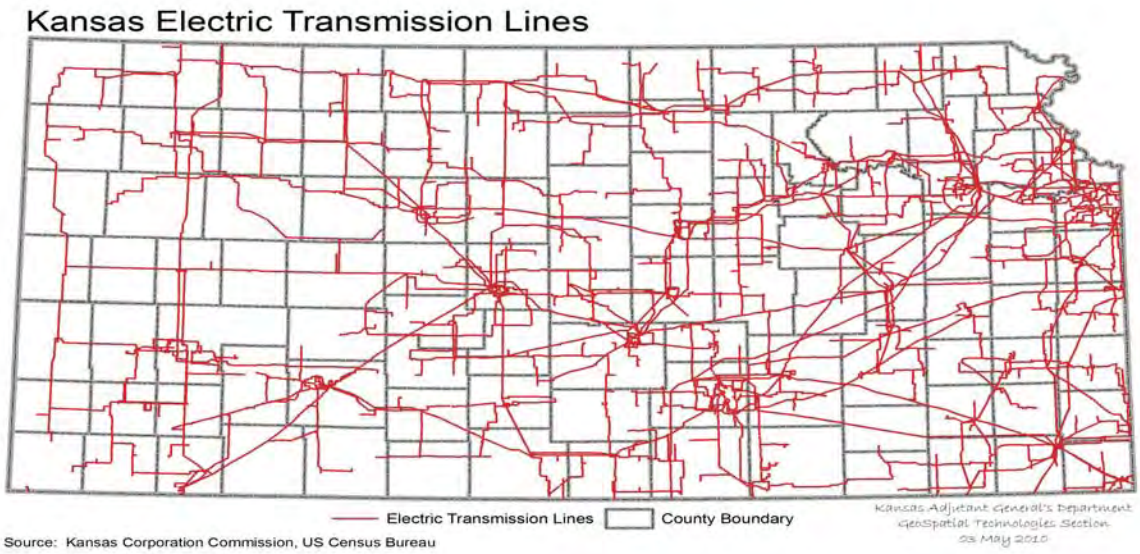


Figure 3.68. Electric Plants, Substations, and Power Plants

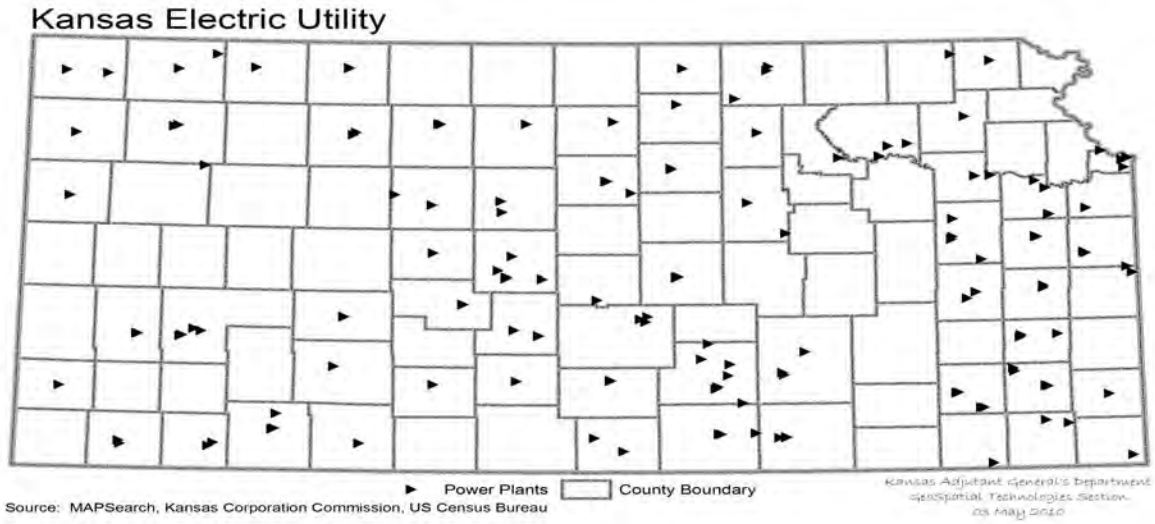
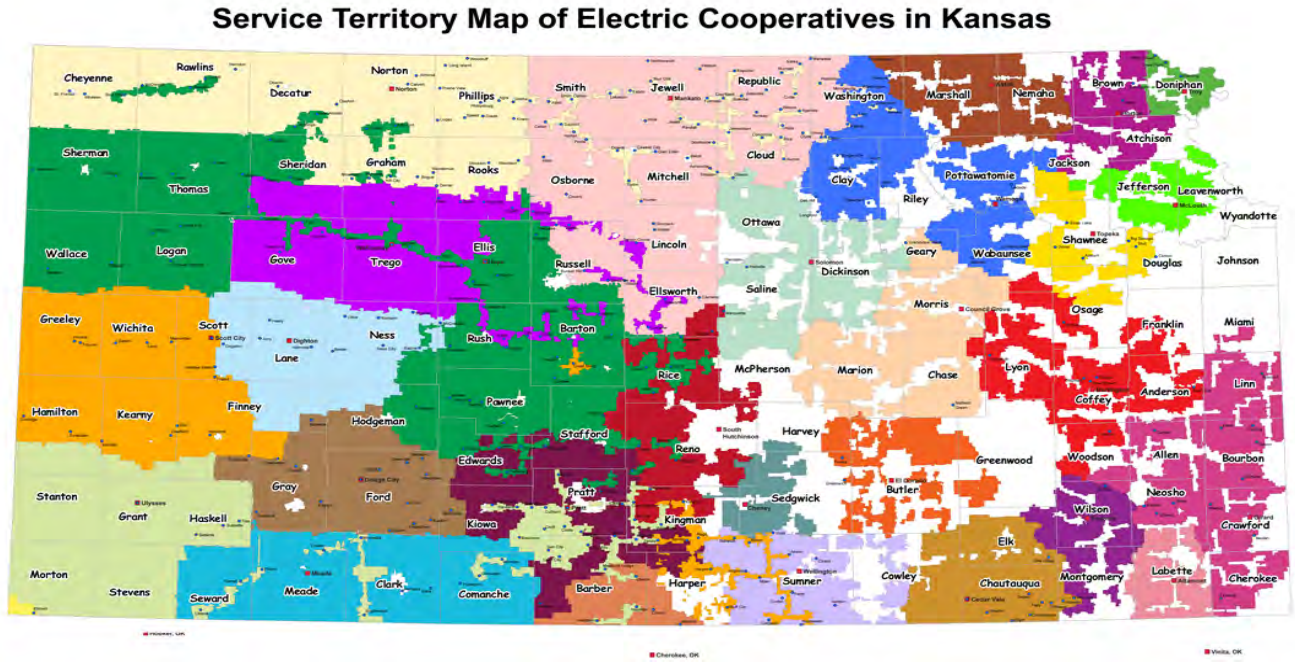
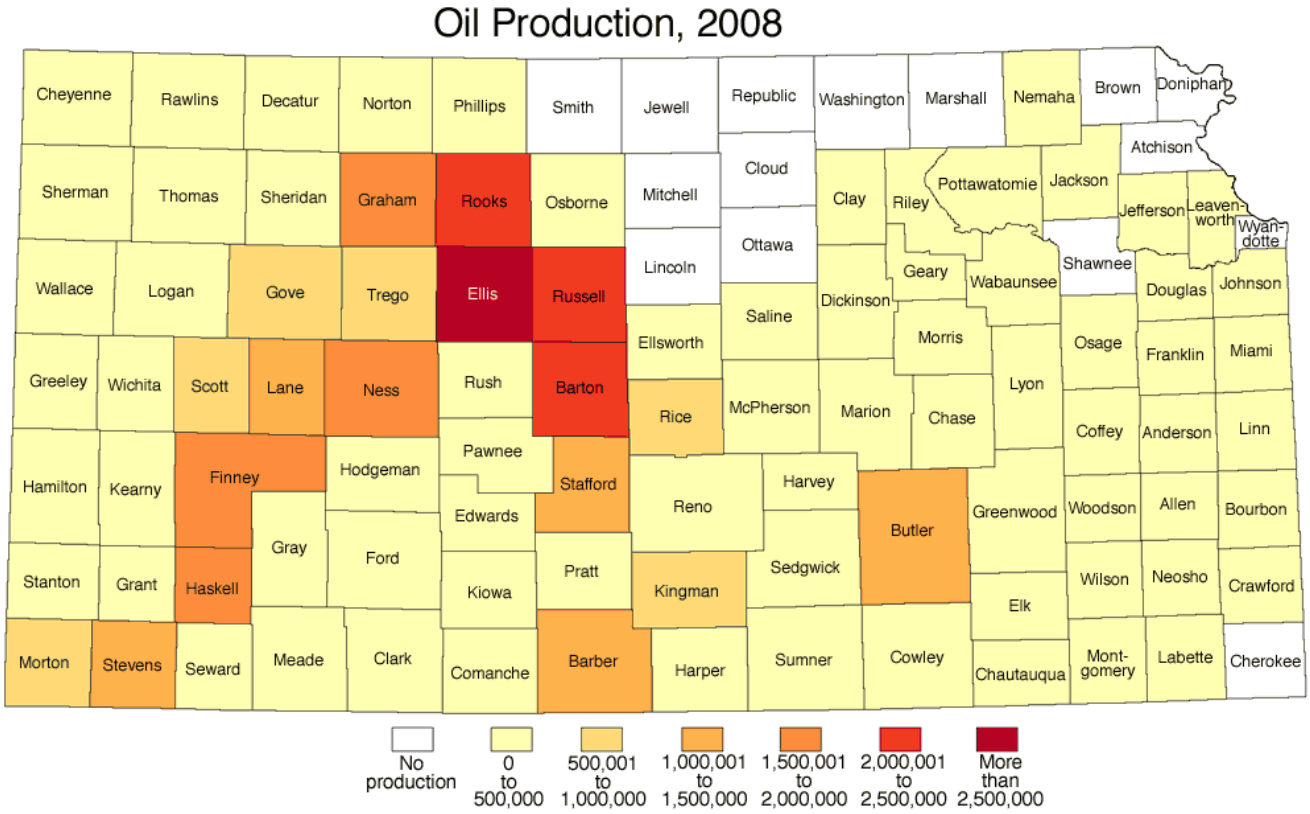


Figure 3.69.Map of Electric Cooperatives in Kansas



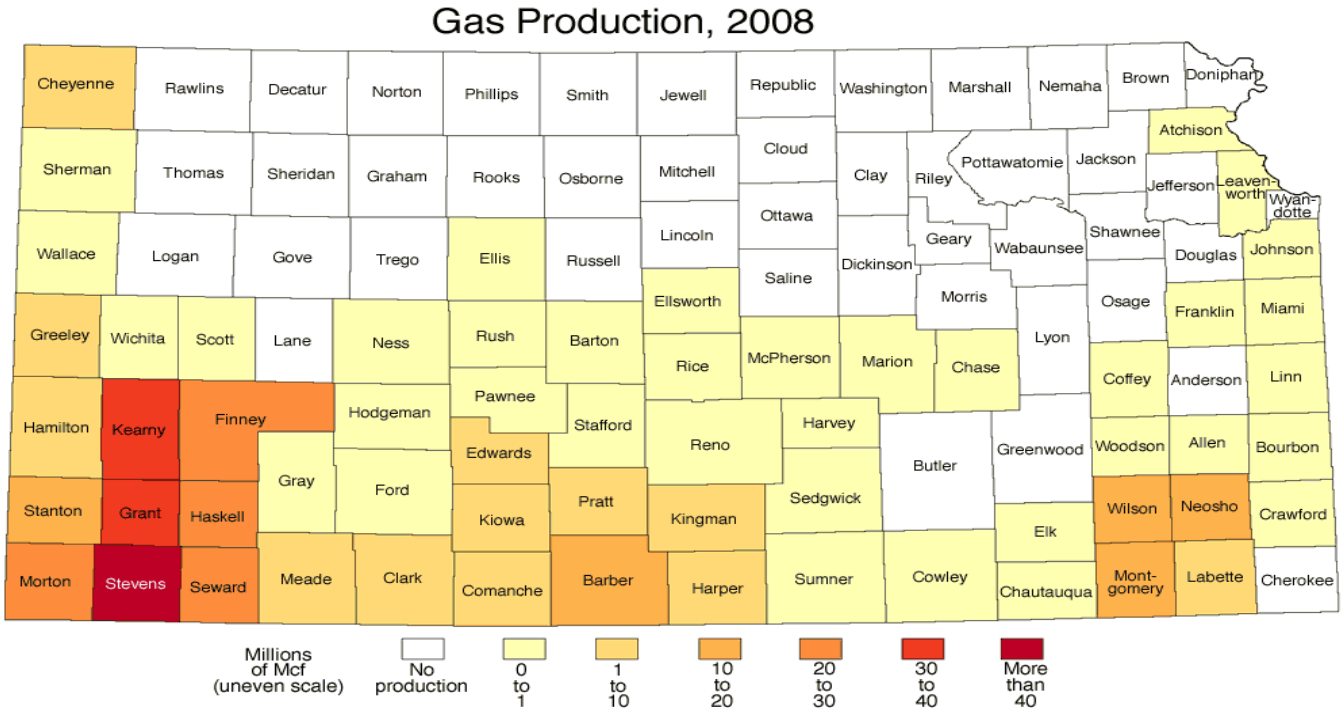
In 2008, the top 10 oil producing counties in Kansas were: Ellis, Rooks, Russell, Ness, Barton, Haskell, Finney, Graham, Stafford, and Barber. The top 10 gas producing counties were Stevens, Grant, Kearny, Haskell, Finney, Seward, Morton Stanton, Barber, and Wilson.

Figure 3.70.Oil Production by County



Source: Kansas Division of Emergency Management

Figure 3.71.Gas Production by County



Source: Kansas Division of Emergency Management

Previous Occurrences

- 1993 - The 1993 Flood is an extreme example of disruption of Kansas' infrastructure. Not only were roads and rivers un-navigable for weeks and months following the flood, but power lines were swept away causing disruption of communication and power services. Tornadoes and winter storms are other natural hazards that frequently cause service disruptions in Kansas. During the summer of 2006, a heat wave caused two train derailments and rerouting of train traffic. The derailments were caused by "sun kinks": the metal tracks expanded from the heat. One train derailed north of Topeka toward Atchison, and the other derailed immediately east of Neosho Rapids. The train that derailed near Neosho Rapids had five cars that contained hazardous materials; none of them were compromised.
- 2009 - In November of 2009 an estimated seven inches of heavy wet snow was reported six miles east of Marysville. Rolling Hills Electric Cooperative stated that around 750 power poles were snapped because of downed lines in Republic, Washington and Marshall Counties. The 1.6 million dollar damage estimate is for all counties combined.

Probability

Based on historical records, utility failures occur annually across the State of Kansas. For ranking purposes, the mitigation planning team elected to only factor significant failures for the probability ranking. This hazard's CPRI probability for significant events is "**Likely**" within the next three years.

Probability Matrix

The matrix below serves to detail probability rankings for each hazard.

Hazard	Utility Failure Event	Y	N
4 - Highly Likely	Event is probable within the calendar year		x
	Event has up to 1 in 1 year chance of occurring (1/1=100%)		x
	History of events is greater than 33% likely per year		x
	Event is "Highly Likely" to occur		x
3 - Likely	Event is probable within the next three years	x	
	Event has up to 1 in 3 years chance of occurring (1/3=33%)	x	
	History of events is greater than 20% but less than or equal to 33% likely per year	x	
	Event is "Likely" to occur	x	
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

Vulnerability and potential losses to the Utility/Infrastructure failure hazard are discussed in Section 3.4 State Facilities: Vulnerability and Potential Loss.

Development in Hazard-Prone Areas

Not applicable to this hazard.

3.3.20 Wildfire

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.20	6 of 22	**High**

Description

Wildfires in Kansas typically originate in pasture or prairie areas following the ignition of dry grasses (by natural or human sources). About 75% of Kansas wildfires start during spring because of dry weather conditions. Since protecting people and structures takes priority, a wildfire's cost to natural resources, crops, and pastured livestock can be ecologically and economically devastating. In addition to the health and safety impacts to those directly affected by fires, the state is also concerned about the health effects of smoke emissions to surrounding areas.

Wildfires in Kansas are frequently associated with lightning and drought conditions, as dry conditions make vegetation more flammable. As new development encroaches into the wildland-urban interface (areas where development occurs within or immediately adjacent to wildlands, near fire-prone trees, brush, and/or other vegetation), more and more structures and people are at risk. On occasion, ranchers and farmers intentionally ignite vegetation to restore soil nutrients or alter the existing vegetation growth. These fires have the potential to erupt into wildfires.

Location

The risk of wildfire varies based on season, drought conditions, and location in the state. However, because of the primarily rural, agricultural characteristics of the state, most, if not all, of Kansas' counties are susceptible to wildfires. The wildfire risk is moderate in the eastern part of the state and somewhat less in the western part. This is largely because of the rapid growth and resulting increasing encroachment into the wildland-urban interface.

Development in the urban interface is best assessed on a local basis, because of the site-specific nature of the hazard and the neighborhoods at risk. Therefore, the KHMT anticipates that, as the hazard identification and risk estimation analyses become available from local mitigation plans, the generalized assessment presented here will be modified and improved.

The issue of smoke emissions is more of a concern in the eastern part of the state because of the higher populations.

More information about location can be found in the Previous Occurrences below as well as in Appendix P Kansas Wildfire Vulnerability.

Previous Occurrences

According to data from the Kansas State Fire Marshal's Office, between 2003 and 2006, Kansas experienced 22,806 wildland/crop fires across 482,264 acres. Dollar losses totaled $4 million (in 2006 dollars). There were 38 fire service injuries, 12 civilian injuries, two fire service deaths, and three civilian deaths. Thus, on average, Kansas experiences 5,702 wildland/crop fires across 120,566 acres, $1 million in losses, 10 fire service injuries, three civilian injuries, and 1 civilian death each year. In 2006 alone, wildfires swept across 198,206 acres in the state and caused $2.4 million in damage. Drought played a big role in the fires of 2006. Of the 8,216 wildland/crop fires, 70% were less than 10 acres. Only 14 of the fires were greater than 1,000 acres, and only four were greater than 5,000 acres. Efforts were made to obtain wildfire loss data prior to 2003 from the Kansas State Fire Marshal's Office, but the information was not available. Updates to this plan will incorporate more fire loss information as it is tracked annually into the future.

There were 5,876 wildland fires between 2007 and 2009 according to the Kansas State Fire Marshal's Office. These fires resulted in over 560,000 acres burned. The total amount of property loss incurred was $3,547,736. There were two firefighter deaths related to wildland fires from 2007 to 2009 and one firefighter death in 2010. There were three civilian deaths related to wildland fires from 2007 to 2009 and there has been one civilian death in 2010.

Notable Kansas Wildfires

- April 12, 2010 – A firefighter was killed while fighting a rural brush fire just to the west of Peru, Kansas.
- March 15, 2010 - A Fredonia woman was found dead after a field fire trapped her in rural Labette County. When deputies arrived, they found that numerous people had been conducting a controlled burn on a grassy field and that a woman had become trapped by the fire and died.

Photo by: Liz Roll/FEMA

- July 30, 2006—Two large wildfires burned out of control for several hours across portions of Ellsworth and Lincoln Counties, consuming 1,000 acres of grassland. Utility poles, trees, and fence lines were destroyed, but no major structures were lost. Damage was estimated at $10,000.
- March 30, 2006 (FEMA-2632-FMA: Obee Fire)—A wildfire burned 5,400 acres east of the Hutchinson Airport. It was likely started by a lightning strike from thunderstorms early that

afternoon. Three hundred to four hundred people were evacuated from a 21 square-mile area. The fire destroyed five houses and 20 outbuildings. Numerous campers, automobiles, and farm implements were damaged or destroyed. Scattered power outages were reported. Damage was estimated at $1.1 million. This incident marked the state's first request for federal fire management assistance.

- March 8, 2006—This large fire started just east of Towanda and, fed by drought conditions and very strong southwesterly winds, spread quickly. The fire started as an accident involving sparks from a trailer on K-254. The fire caused thick smoke across the Kansas Turnpike, which resulted in a two-car accident and eventually shut the roadway down for 45 minutes. The fire charred 10,700 acres of grassland, damaged or destroyed 10 outbuildings, caused minor damage to two homes, set three oil wells ablaze, and caused the evacuation of Oil Hill Elementary School.
- February 9, 2006—A large grass fire along the Reno/Harvey County line erupted just north of Burrton and spread quickly, fed by drought conditions and sustained winds of 25 to 35 mph. The fire was believed to be extinguished that evening but around noon on February 10 the fire reignited as strong winds once again swept across the area. The fire was eventually extinguished late in the day on February 10. The fire burned 8,800 acres and caused approximately $30,000 in damage to ranch and farmland.
- May 14, 2003—There was a large grass fire in Kanopolis State Park in Ellsworth County that required evacuation of campers, threatened several structures, and necessitated deployment of a Kansas National Guard helicopter to extinguish the blaze.
- April 18, 2000—The western United States was experiencing increased wildfires, and many areas were severely affected. Kansas experienced increased grassland fires during this period of extra risk, which can be attributed primarily to the severe drought occurring at the time.
- April 1, 1998—Over 100 acres of grass burned and two cabins were destroyed in a wildfire in Scott County that caused approximately $150,000 in damage.
- February 24, 1996—A fast moving grass fire in northeast Kansas consumed 25 square miles (25,000 acres) of grass and timber and required the evacuation of part of the town of Auburn. The fire was stopped about a half mile from the town, preventing any significant property damage. Three firefighters were injured and two homes and several other buildings were destroyed. Property damages were estimated at $250,000.

Local Plan Integration:

For the 2010 plan update, the committee reviewed all FEMA-approved local mitigation plans and gathered the following data for wildfires:

Table 3.76.Local Plan Statistics for Wildfire Events

Wildfire						
County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	Moderate	134	N/A	N/A	N/A	N/A
Brown	High	233	N/A	N/A	N/A	N/A
Butler	Moderate	N/A	N/A	N/A	N/A	N/A
Chase	Low	N/A	N/A	N/A	N/A	N/A
Cherokee	Moderate	N/A	N/A	N/A	N/A	N/A
Cloud	Moderate	N/A	N/A	N/A	N/A	N/A

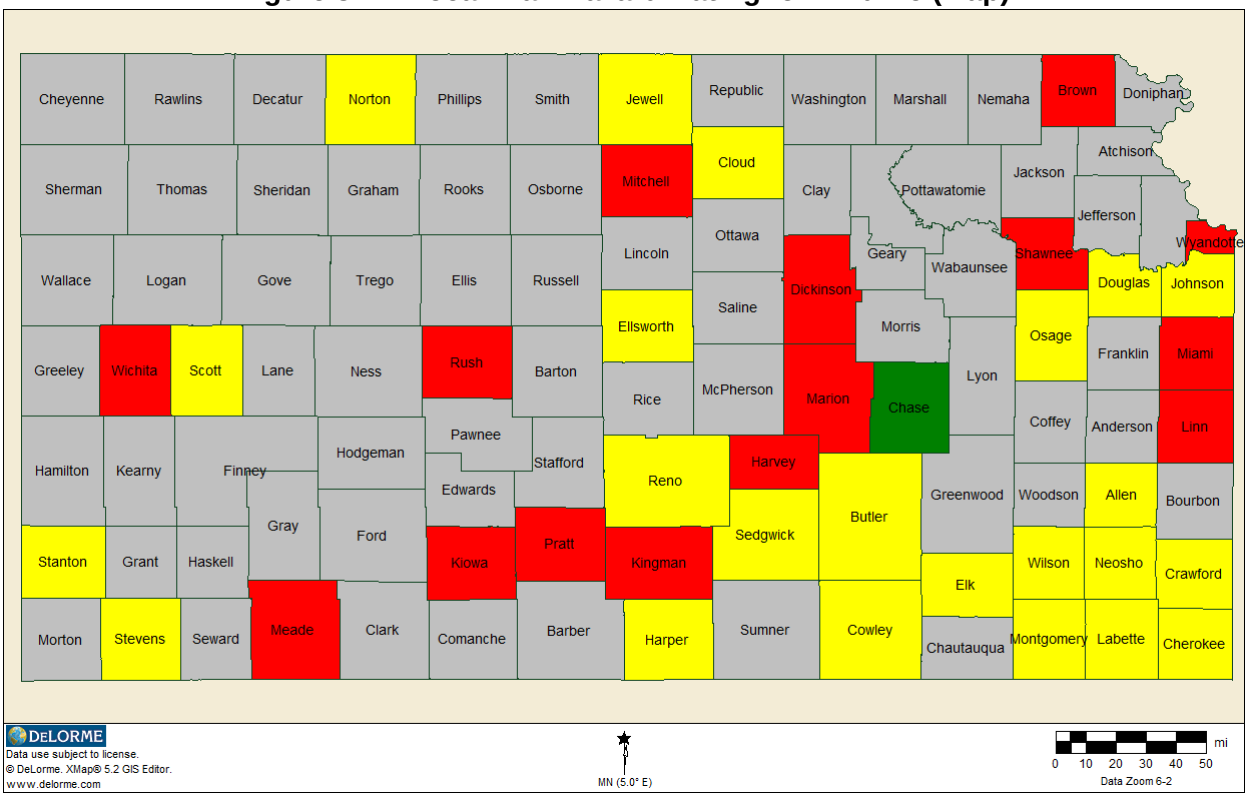
Wildfire						
County	**Hazard Ranking**	**# of Events**	**Damages (Prop)**	**Damages (Crop)**	**Injuries**	**Fatalities**
Cowley	Moderate	N/A	N/A	N/A	N/A	N/A
Crawford	Moderate	457	N/A	$930,900.00	N/A	N/A
Dickinson	High	655	N/A	$880,000.00	N/A	N/A
Douglas	Moderate	186	N/A	$779,630.00	1	N/A
Elk	Moderate	299	$1,354,709.00	N/A	1	N/A
Ellsworth	Moderate	1	$10,000.00	N/A	N/A	N/A
Harper	Moderate	86	N/A	N/A	N/A	N/A
Harvey	High	355	$2,588,700.00	N/A	N/A	N/A
Jewell	Moderate	N/A	N/A	N/A	N/A	N/A
Johnson	Moderate	935	$11,883,005.00	N/A	N/A	N/A
Kingman	High	261	$264,000.00	N/A	N/A	N/A
Kiowa	High	138	$5,000.00	N/A	N/A	N/A
Labette	Moderate	661	$1,259,760.00	N/A	N/A	N/A
Linn	High	N/A	N/A	N/A	N/A	N/A
Lyon	N/A	N/A	N/A	N/A	N/A	N/A
Marion	High	N/A	N/A	N/A	N/A	N/A
Meade	High	N/A	N/A	N/A	N/A	N/A
Miami	High	N/A	N/A	N/A	N/A	N/A
Mitchell	High	N/A	N/A	N/A	N/A	N/A
Montgomery	Moderate	N/A	N/A	N/A	N/A	N/A
Neosho	Moderate	148	$123,400.00	N/A	N/A	N/A
Norton	Moderate	N/A	N/A	N/A	N/A	N/A
Osage	Moderate	846	$1,912,410.00	N/A	N/A	N/A
Pratt	High	N/A	N/A	N/A	N/A	N/A
Reno	Moderate	566	$2,374,395.00	N/A	N/A	1
Rush	High	146	$311,275.00	N/A	2	4
Scott	Moderate	N/A	N/A	N/A	N/A	N/A
Sedgwick	Moderate	2777	$10,650,796.00	N/A	N/A	N/A
Shawnee	High	N/A	N/A	N/A	N/A	N/A
Stanton	Moderate	103	$1,158,300.00	N/A	3	N/A
Stevens	Moderate	N/A	N/A	N/A	N/A	N/A
Wichita	High	N/A	N/A	N/A	N/A	N/A
Wilson	Moderate	380	$2,061,260.00	N/A	10	1
Wyandotte	High	271	$2,087,715.00	N/A	16	1
Total		**9638**	**$38,044,725.00**	**$2,590,530.00**	**33**	**7**

After reviewing the data from the local plans throughout the State of Kansas, the committee calculated averages for wildfires, as shown in the table located below; the state can expect an average of $4,216 in damages from a single wildfire event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate. Included is a map illustrating each jurisdiction's own rating for this hazard in their planning areas.

Table 3.77. Local Plan Averages for Wildfire Events

	Deaths	Injuries	Total Damages
Totals	7	33	$40,635,255
Average Per County	0.175	0.825	$1,015,881
Average Per Event	0.0007	.003	$4,216

Figure 3.72. Local Plan Hazard Rating for Wildfire (Map)

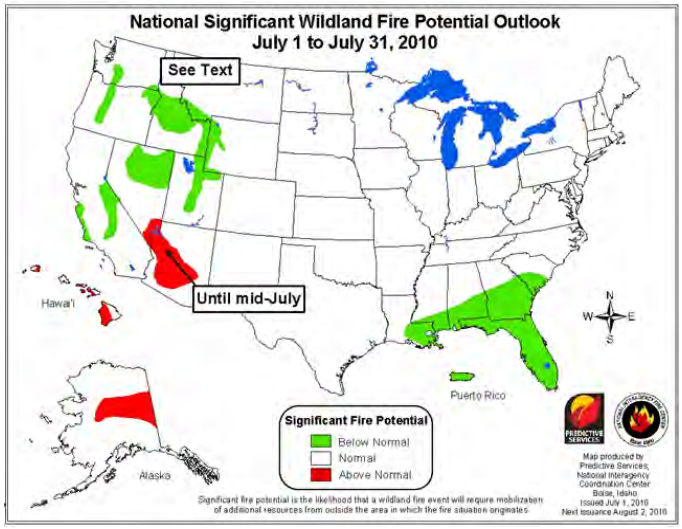


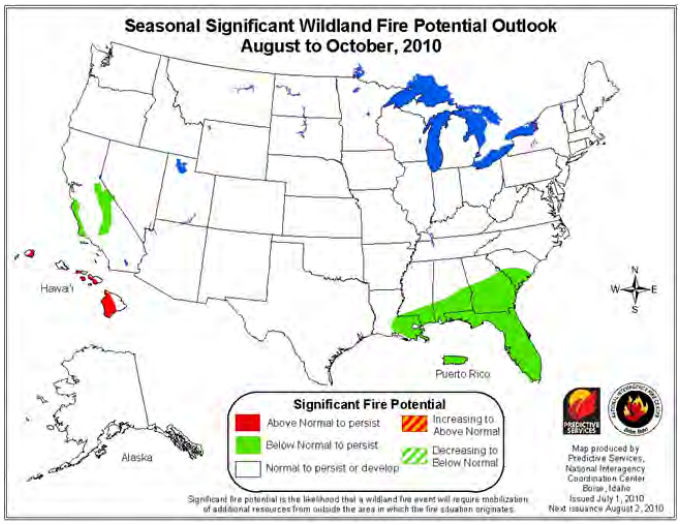
Source: Bold Planning Solutions

Red – High Risk – 15 Jurisdictions
Yellow – Moderate Risk – 23 Jurisdictions
Green – Low Risk – 1 Jurisdiction
Gray – No Plan / No Rating – 66 Jurisdictions

Probability

Since wildfires occur on an annual basis, this hazard's CPRI probability is "**Highly Likely**" within the calendar year. Although wildfires occur every year the outlook for July – October 2010 is promising. The entire state is in the "Normal" rating for fire potential.





Hazard	Wildfire Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

According to data from the Kansas State Fire Marshal Office, between 2003 and 2006, Kansas experienced 22,806 wildland/crop fires across 482,264 acres. Dollar losses totaled $4 million. There were 38 fire service injuries, 12 civilian injuries, two fire service deaths, and three civilian deaths. Thus, on average, Kansas experiences 5,702 wildland/crop fires across 120,566 acres, $1 million in losses, 10 fire service injuries, three civilian injuries, and one civilian death each year. More detail on the impacts by county, aside from acres burned, was not available.

Table 3.76 lists acres burned, by county between 2003 and 2006, sorted on total acres burned, as an indication of where potential wildfires could occur. The counties that totaled 10,000 acres or more burned in that time frame are in the eastern half of the state, with only a few exceptions.

There were 5,876 wildland fires between 2007 and 2009 according to the Kansas State Fire Marshal's Office. These fires resulted in over 560,000 acres burned. The total amount of property loss incurred was $3,547,736. The average of damage for the events between 2007 and 2009 was $1,182,578. There were two firefighter deaths related to wildland fires from 2007 to 2009 and one firefighter death in 2010. There were three civilian deaths related to wildland fires from 2007 to 2009 and there has been one civilian death in 2010. County level data for wildland fires between 2007 and 2009 was not available at the time of the 2010 plan revision.

Table 3.78 Acres Burned by County 2003–2006

County	Acres Burned	County	Acres Burned	County	Acres Burned
Greenwood	38,708	Geary	3,651	Trego	1,494
Pottawatomie	35,708	Dickinson	3,573	Lane	1,450
Butler	26,825	Logan	3,366	Leavenworth	1,391
Chase	21,768	Rice	3,311	Lincoln	1,355
Meade	19,613	Pawnee	3,118	Johnson	1,113
Elk	15,373	McPherson	3,043	Washington	1,089
Finney	13,127	Saline	3,042	Rawlins	1,079

County	Acres Burned	County	Acres Burned	County	Acres Burned
Graham	12,409	Clay	3,039	Rush	1,058
Chautauqua	11,966	Kingman	2,956	Stevens	1,037
Coffey	11,829	Reno	2,919	Mitchell	1,036
Harvey	11,774	Sumner	2,872	Cheyenne	1,020
Osage	10,831	Jewell	2,872	Barton	1,005
Shawnee	7,900	Stafford	2,865	Rooks	932
Cowley	7,307	Pratt	2,829	Barber	859
Jackson	7,209	Anderson	2,818	Osborne	850
Hamilton	7,009	Marion	2,772	Thomas	667
Morris	6,587	Doniphan	2,705	Grant	654
Bourbon	6,532	Crawford	2,611	Edwards	646
Clark	6,473	Stanton	2,567	Haskell	586
Woodson	6,080	Morton	2,558	Smith	582
Wabaunsee	6,033	Greeley	2,456	Ellis	582
Cherokee	5,652	Ellsworth	2,329	Comanche	552
Linn	5,220	Wilson	2,287	Norton	537
Sedgwick	5,214	Republic	2,242	Ness	532
Sherman	5,149	Miami	2,184	Allen	517
Riley	4,734	Kearny	2,150	Wyandotte	504
Neosho	4,396	Douglas	2,073	Sheridan	464
Marshall	4,340	Brown	1,973	Atchison	393
Franklin	4,257	Nemaha	1,920	Gray	344
Kiowa	4,220	Wallace	1,867	Seward	291
Ottawa	4,019	Jefferson	1,837	Scott	274
Montgomery	3,915	Cloud	1,811	Decatur	89
Harper	3,841	Phillips	1,794	Wichita	50
Hodgeman	3,749	Ford	1,785	Gove	35
Labette	3,673				
Source: 2003, 2004, 2005, 2006 Kansas Incident Fire Reporting System					

Wildland-urban interface maps are not available from the state so it is not possible to further assess vulnerability and potential losses by jurisdiction. As risk assessments from local mitigation plans become available, the estimated risk to individual counties from wildfires can be more accurately documented.

Development in Hazard-Prone Areas

Without wildland-urban interface maps it is not known if development is occurring in hazard areas.

3.3.21 Windstorm

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.35	3 of 22	**High**

Description
Relatively frequent strong winds are a weather characteristic of Kansas. Figure 3.60 shows the wind zones of the United States based on maximum wind speeds; Kansas is located within wind zones III and IV, the highest inland categories. High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss.

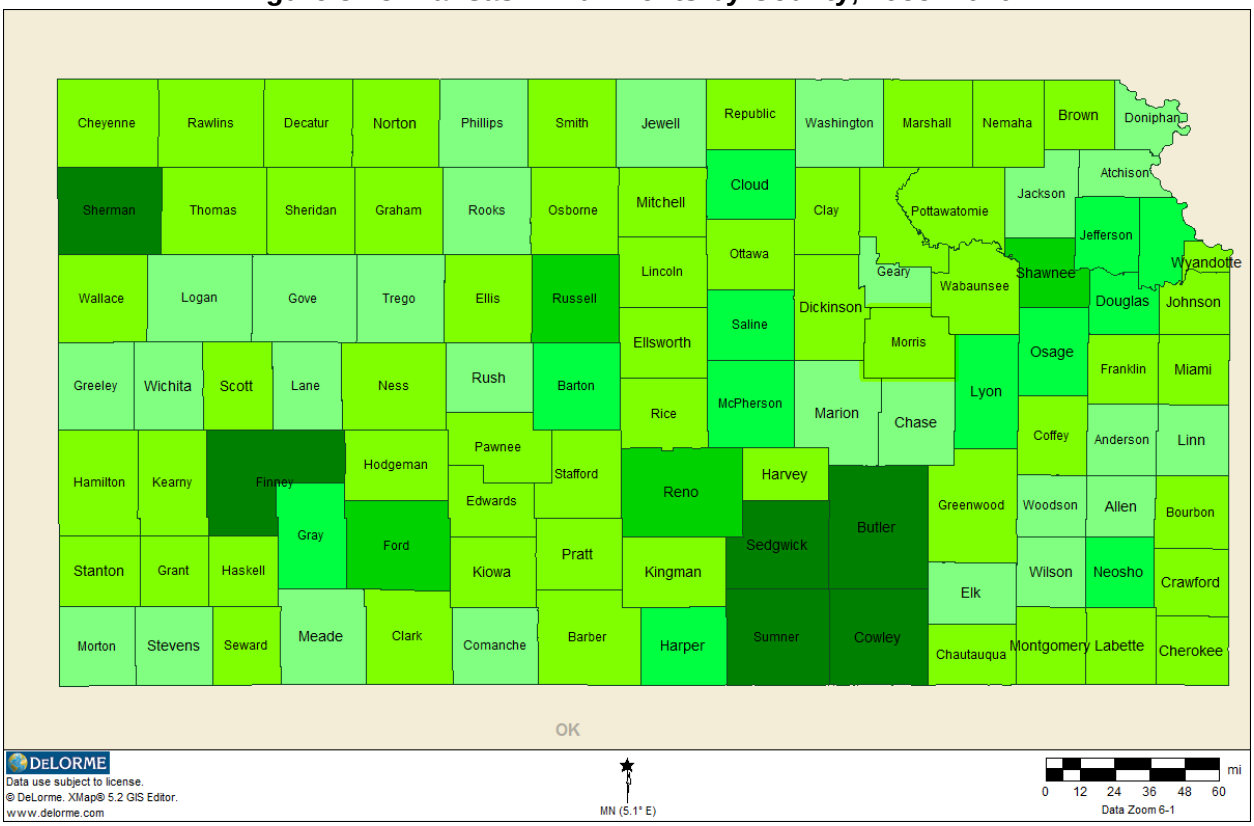
Straight-line winds are generally any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 mph that represent the most common type of severe weather and are responsible for most wind damage related to thunderstorms. Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns, outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase. In 2005, hail and wind damage made up 45% of homeowners' insurance losses. One type of straight-line wind is the downburst, which can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation.

Thunderstorms over Kansas typically happen between late April and early September, but, given the right conditions, they can develop as early as March. They are usually produced by supercell thunderstorms or a line of thunderstorms that typically develop on hot and humid days.

Location
All of Kansas is susceptible to high wind events. Most of Kansas is in Zone IV, which is susceptible to winds up to 250 mph. The western third of the state is in Zone III, which is susceptible to winds up to 200 mph. More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences
According to the National Climatic Data Center Storm Events database, there were 14,478 wind events in Kansas between 1950 and 2010 (non-winter storm-related events that occurred between April and the end of September). There were nine deaths and 282 injuries in this time period. Total property and crop damage for events between 1993 and 2010 is estimated at $457.088 million. This suggests that Kansas could experience 241 wind events, $26,887,529 million in wind losses, and approximately five injuries each year. (Data limitation: NCDC receives storm data from the National Weather Service (NWS), which receives information from a variety of sources, which include but are not limited to county, state, and federal emergency management officials, local law enforcement officials, Skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the general public. The wind events represent wind reports, not necessarily individual storms, and thus likely over count the actual number of windstorms.) See the section on Vulnerability and Potential Losses by Jurisdiction for more information about how wind affects individual counties.

Figure 3.73. Kansas Wind Events by County, 1955–2010



Source: Bold Planning Solutions

- **304 – 374 Events**
- **230 – 303 Events**
- **156 – 229 Events**
- **82 – 155 Events**
- **0 – 44 Events**

- July 8, 2009 - Several power poles, permanent structures, outbuildings, and trees were heavily damaged when a strong thunderstorm went through the area. The heaviest damage occurred at Ottawa Airport where a hangar filled with a collection of small aircraft collapsed. The hangar and aircraft all sustained heavy damage. The NWS survey crew could not get an exact number of power poles that were snapped, but can estimate over 100 destroyed power poles.
- May 8, 2009 - A large swatch of damaging winds moved across the area from Benton to Rosalia including the city of El Dorado with winds measured at 80 mph at the Jefferson Elementary School in El Dorado. Numerous large trees were knocked down in Benton, with a mobile home trailer rolled over east of town. The damaging winds destroyed the historic stone silo bearing the name of the town of Towanda. The damaging winds estimated at 70 to 80 mph moved into El Dorado damaging roofs to numerous businesses in downtown and knocking down numerous large trees. Two or three schools in El Dorado had their roofs

partially peeled off. The refinery in El Dorado had some large storage tanks dented. The damaging winds continued to move east downing almost every one of the large transmission lines along US 54 highway from El Dorado to Rosalia.

- October 21, 2008 - Thunderstorm winds were estimated to be from 90 to 100 mph in Kearny County near Lakin. A mobile home was destroyed and another was heavily damaged. Two occupants of the destroyed trailer were injured, none seriously. There were also 16 pivot irrigation sprinklers overturned in a four-mile radius of this location. In addition, 20 power poles were snapped and a large grain bin was destroyed. Large hay bales were blown around and all windows in the machinery and vehicles were blown out.
- June 5, 2008 - Upper level and surface low pressure systems, both shifting east into the Central Plains, brought a round of strong to severe thunderstorms to north central Kansas during the afternoon and early evening hours. These thunderstorms were aided by a surface front draped across the region, along with boundaries left from previous convection. Hail the size of golf balls and wind gusts near 60 mph were reported. There was one report of winds gusting to around 100 mph near Stockton in Rooks County.
- September 6, 2007—Thunderstorm outflow winds estimated at close to 90 mph in McDonald resulted in damage to grain bins, a trailer home, and a large storage building. Four power poles were snapped, resulting in a power outage lasting several hours in McDonald and Bird City.
- May 5, 2007—Straight-line winds in Clay County estimated at 80 to 90 mph damaged numerous farm buildings, grain bins, homes, trees, outbuildings, and power poles. Wind damage from straight-line winds estimated at 70 to 80 mph was found across Washington County.
- August 25, 2006—Straight-line winds up around 80 mph produced significant damage in northwest Morris County. Train cars were derailed, an old theater was damaged, and farm outbuildings and implements were damaged.
- August 2006— Pulse thunderstorms impacted the area on August 9 and 26. Power lines were downed from microburst winds in Crawford and Cherokee Counties. Power pole damage was estimated at $17,000.
- July 26, 2006— A microburst that produced up to 120 mph winds destroyed a house just north of Spearville. Wind speeds as high as 120 mph also destroyed a grain bin and cattle shed in the area and damaged trees and tombstones in a cemetery. One injury was reported.
- June 16, 2006—Severe thunderstorms produced straight line winds of 60 to 75 mph across Morris, Dickinson, Lyon, Wabaunsee, and Shawnee Counties. Damage to trees and structures was reported. Straight-line winds between 60 and 80 mph also did damage in Kingman, Sedgwick, and Marion Counties.
- May 18, 2005—Downburst winds estimated around 80 mph in southern Osage County damaged train cars, knocking 24 cars off the tracks.
- April 23, 2006—Large hail and straight-line winds were reported in northeast Kansas. Straight-line winds of 70 mph blew roofs off two boat houses on Perry Lake Marina.
- March 12, 2006—A severe thunderstorm produced straight-line winds of up to 90 mph and damage throughout Lawrence. Seventy buildings on the University of Kansas campus were damaged, semi-trailers were overturned, 60-foot silos fell, and homes and trees were damaged. Damage was estimated at $8 million. Severe straight-line winds in Frontenac caused structure damage estimated at $20,000.
- August 19, 2005—The severe thunderstorms that brought a tornado to Great Bend were also packed with 75-80 mph winds, which caused an estimated $5 million in damage in and

around the city. Many buildings sustained major roof and structural damage. Numerous vehicles sustained smashed or shattered windows. Twelve people were injured. Wind damage in McPherson County was estimated at $150,000.

- July 3, 2005—Severe thunderstorms struck central and south-central Kansas. Winds between 70 and 100 mph caused extensive damage at Cheney Lake State Park, where the marina, around 125 boats, and 35 campers and mobile homes were either heavily damaged or destroyed. One person was killed when his boat overturned; six others were injured. Estimated damage from these storms was $2 million to property and $12.5 million to agriculture. The governor issued a state of disaster emergency for Reno County. In Harper County, a few buildings were unroofed in Bluff City by winds estimated around 85 mph.
- June 30, 2005—In Neosho County, severe thunderstorms unleashed 90 mph winds that blew roofs off many homes and businesses in Chanute. In Erie and St. Paul, large trees were uprooted and fell onto other homes, destroying one. Many barns and sheds were also destroyed. Total damage in all three towns was $2 million.
- July 7, 2004—Reports of 75 to 90 mph winds in the area around Beloit caused some structural and tree damage. Strong winds also caused damage in Rooks County, especially in the community of Plainville.
- July 4, 2004—A damaging wind storm known as a derecho tracked across extreme southeast Kansas. The most significant damage was in Cherokee County where several homes were destroyed or severely damaged.
- June 15, 2004—Thunderstorm downburst winds between 70 and 90 mph brought down power poles in Wallace and Thomas Counties and damaged a storage complex and a city well building in Colby. Decatur County winds near 100 mph west and southwest of Oberlin brought down trees and power lines and damaged outbuildings.
- May 29, 2004—Strong thunderstorm downdrafts of 60 to 90 mph developed and produced widespread damage to trees, power lines, roofs, and fences in western Kansas. As the downdrafts gained momentum, strong winds raced out well ahead of the thunderstorm rain cores. The strong winds collected a huge volume of dirt, sending it many hundreds of feet into the air, which produced a literal wall of dirt and resulted in instant blackout conditions similar to the 1930s Dust Bowl. Visibilities were reduced to tens of feet in some instances. Traffic on I-70 was adversely affected. Several pileups occurred. Two lives were lost.
- April 23, 2004—Strong winds in excess of 60 mph caused significant damage over Harper County. Three people were injured when the Historic Fairground Barn collapsed.
- August 11, 2003—A pair of severe thunderstorms struck south-central Kansas. The first left thousands of residents without power in the Wichita area after 70-80 mph winds snapped power poles. The area hardest hit by the second storm was El Dorado Lake, where winds estimated at 70-80 mph caused two minor injuries at the campgrounds along with wind damage to the marina docks. The storm continued to produce straight-line wind damage as it tracked across Cowley County.
- July 10, 2003—Straight-line winds from a downburst occurred near the Wichita Greyhound Park north of Wichita. Portions of the roof were peeled off, numerous vehicles were damaged, and power lines were blown down. Significant wind damage also occurred around El Dorado, where trees and power lines were blown down and shingles were blown off a Pizza Hut. Another long swath of wind damage started near Douglass and continued through Atlanta and on into southeast Kansas. A hangar was blown over at the airport in Eureka, and considerable tree damage was observed around Independence.

- July 5, 2003—A heat burst (an intense thunderstorm downdraft accompanied by pronounced warming) that developed over Wallace and Logan Counties and moved into Sherman and Thomas Counties damaged barns, trees, and power poles and resulted in numerous traffic accidents as winds gusted over 70 mph, stirred up dirt, and lowered visibility.
- August 13, 2002—Winds up to 100 mph impacted northern Reno County. In Nickerson, many trees were knocked down, some sheds were damaged or destroyed, and power was lost in the city. In South Hutchinson, 25 train box cars were blown over, three mobile homes were destroyed, several homes lost their roofs, and several large trees were snapped or uprooted.
- August 2002—An intense microburst wind event in St. Francis caused a swath of damage approximately five blocks wide and a mile long. Automobiles at a car dealership were damaged and numerous structures sustained roof damage.
- August 2002—A storm had wind speeds from 70-87 knots, causing widespread tree and power line damage. Two single-family and three mobile homes were destroyed. Fifty other structures were damaged. A state of disaster emergency was declared by the governor.
- July 2002—Wind caused $75,000 in property damage and $1 million in crop damage in Jewell County.
- May 2002—Winds in excess of 80 mph near Ports and Harlan blew over empty train cars and caused an estimated $3 million in crop damage.
- April 2002—Winds measured at 82 mph damaged many buildings and businesses in Riley County. Power was knocked out, and a Wal-Mart suffered extensive roof damage, forcing store closure for several days. Total damages from Riley County were estimated at $5 million. During the same episode, winds in Shawnee County exceeded 60 mph, and many homes and businesses were damaged. Shawnee County damages totaled approximately $2 million.
- March 9, 2002—Winds in south-central Kansas gusted up to 87 mph in Cowley County. Large power poles were knocked down and a semi was overturned on the Kansas Turnpike in Butler County. Significant wind damage occurred in Coffeyville in Montgomery County. A large section of roof was blown off a church onto an adjacent building, and part of a stadium was damaged. A few downtown buildings also had windows broken as a result of the strong wind gusts.
- March 2002—A storm caused property damage in several areas of the state. Seventy mile per hour winds significantly damaged a junior high school in Paxico. In Topeka, downburst winds damaged 40 cars at an automobile dealership. Several farm structures were damaged near Altamont.
- September 7, 2001—Winds estimated from 70 to 100 mph tore across east-central Kansas damaging numerous trees and several structures. Damage was especially significant in and around the Lawrence, Baldwin City, Ottawa, and Garnett communities.
- July 10, 2001—Microburst winds of 100 mph produced widespread damage throughout Gaylord in Smith County. Damage was estimated at $400,000.
- June 14, 2001—A line of damaging winds, estimated between 70 and 80 mph caused considerable damage and injured two people near Yates Center on June 14. These winds lifted a couple into the air and blown debris knocked them unconscious.
- April 11, 2001—There were no thunderstorms to be found as mostly sunny skies prevailed. Still, $750,000 in damage occurred in central and south-central Kansas as an unusually strong area of low pressure brought prolonged wind gusts reaching 65 mph. Two people were injured as a result of these winds.

Local Plan Integration

For the 2010 update, the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.79.

Table 3.79.Local Plan Statistics for Wind Events

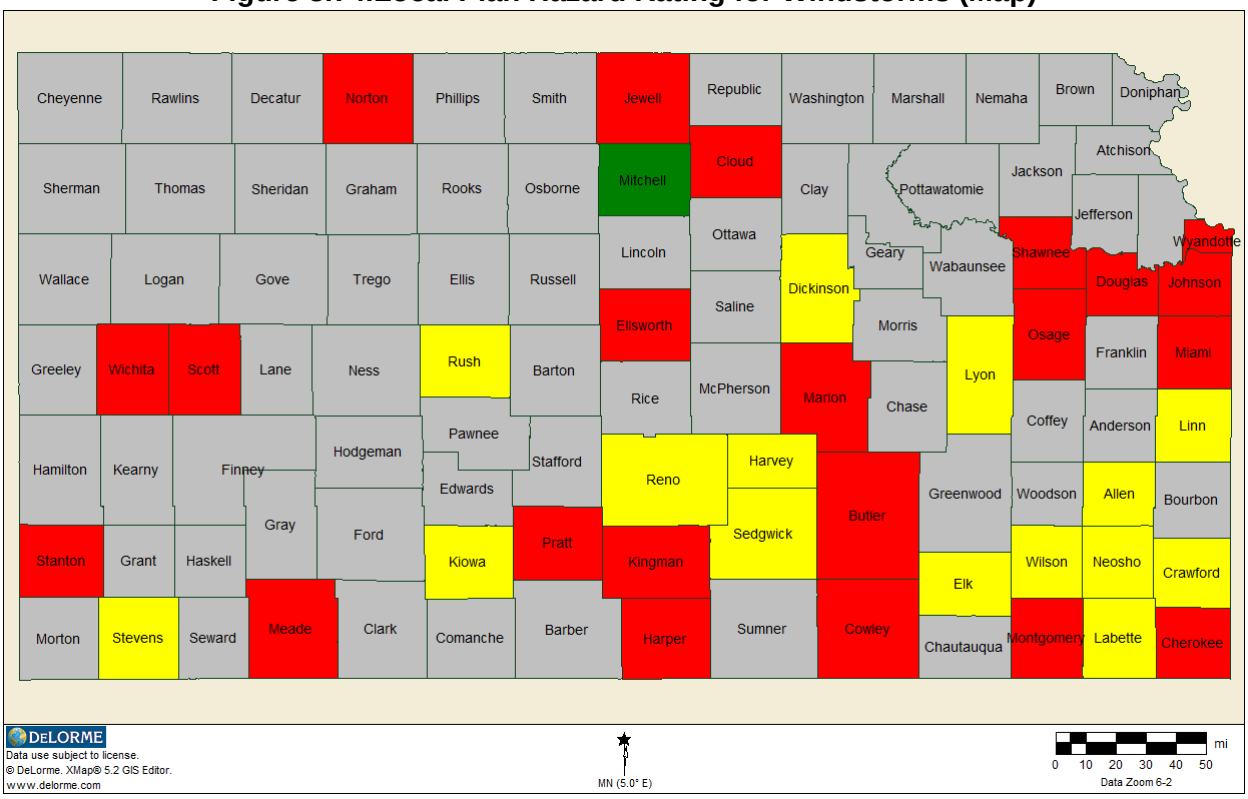
County	Region	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	Southeast	Moderate	60	$1,365,000.00	N/A	N/A	N/A
Brown	Northeast	N/A	105	$4,560,000.00	$532,000.00	0	0
Butler	South Central	High	316	$14,110,000.00	N/A	37	N/A
Chase	Northeast	N/A	N/A	N/A	N/A	N/A	N/A
Cherokee	Southeast	High	105	N/A	N/A	N/A	N/A
Cloud	North Central	High	175	$4,621,000.00	N/A	N/A	N/A
Cowley	South Central	High	3	N/A	N/A	N/A	N/A
Crawford	Southeast	Moderate	87	$1,051,000.00	$1,836,000.00	N/A	N/A
Dickinson	North Central	Moderate	122	$6,300,000.00	$144,000.00	1	N/A
Douglas	Northeast	High	184	$14,644,000.00	$617,000.00	8	N/A
Elk	Southeast	Moderate	45	$74,000.00	N/A	**0**	N/A
Ellsworth	North Central	High	121	$2,535,000.00	N/A	2	N/A
Harper	South Central	High	162	$1,940,000.00	N/A	6	N/A
Harvey	South Central	Moderate	88	$1,500,000.00	N/A		N/A
Jewell	North Central	High	80	$1,751,000.00	$2,541,000.00	1	N/A
Johnson	KC Metro	High	104	$2,043,000.00	N/A	6	1
Kingman	South Central	High	145	$2,000,000.00	N/A	1	N/A
Kiowa	South Central	Moderate	91	$4,300,000.00	$1,150,000.00	5	N/A
Labette	Southeast	Moderate	118	$2,100,000.00	N/A	N/A	N/A
Linn	Northeast	Moderate	43	$292,000.00	N/A	N/A	N/A
Lyon	Northeast	Moderate	N/A	N/A	N/A	N/A	N/A
Marion	South Central	High	N/A	N/A	N/A	N/A	N/A
Meade	Southwest	High	N/A	N/A	N/A	N/A	N/A
Miami	Northeast	High	86	$138,000.00	$2,000.00	N/A	N/A
Mitchell	North Central	Low	96	$2,330,000.00	$2,522,000.00	N/A	N/A
Montgomery	Southeast	High	83	$2,300,000.00	$0.00	0	0
Neosho	Southeast	Moderate	159	$4,180,000.00	N/A	N/A	N/A
Norton	Northwest	High	111	$788,000.00	N/A	6	**0**
Osage	Northeast	High	180	$5,200,000.00	N/A	19	4
Pratt	South Central	High	117	$3,058,000.00	N/A	N/A	N/A
Reno	South Central	Moderate	296	$17,236,000.00	$259,878.00	20	1
Rush	Northwest	Moderate	52	$1,156,000.00	$165,000.00	5	1
Scott	Southwest	High	95	$2,512,000.00	$150,000.00	N/A	N/A
Sedgwick	South Central	Moderate	374	$57,000,000.00	$50,000.00	31	1
Shawnee	Northeast	High	297	$5,420,000.00	$500,000.00	5	**0**
Stanton	Southwest	High	86	$1,000,000.00	$1,000,000.00	5	1
Stevens	Southwest	Moderate	67	$789,000.00	$150,000.00	0	0
Wichita	Southwest	High	44	$510,000.00	N/A	2	0
Wilson	Southeast	Moderate	55	$72,000.00	N/A	N/A	N/A
Wyandotte	KC Metro	High	103	$839,000,000.00	N/A	0	0
Totals			**4455**	**$1,007,875,000.00**	**$11,618,878.00**	**106**	**9**

After reviewing the data from the local plans throughout the State of Kansas the committee calculated averages for wind events. As shown in the table located below, the state can expect an average of $228,842 in damages from a single wind event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.80.Local Plan Averages for Wind Events

	Deaths	Injuries	Total Damages
Totals	9	106	$1,019,493,878
Average per County	0.225	2.65	$25,487,346
Average Per Event	0.002	0.02	$228,842

Figure 3.74.Local Plan Hazard Rating for Windstorms (Map)



Source: Bold Planning Solutions

Red – High Risk – 22 Jurisdictions
Yellow – Moderate Risk – 15 Jurisdictions
Green – Low Risk – 1 Jurisdiction
Gray – No Plan / Rating – 67 Jurisdictions

Probability

According to the National Climatic Data Center, there were 14,478 wind events (excluding events from October through March 31 and those associated with winter storms, see event description above) in Kansas between 1950 and 2010 (60 years). Since 2006, there have been 3,148 wind events reported resulting in a total of 14,478 occurrences. Based on this information, the probability that at least one wind event will occur in Kansas in any given year is 100%. Annualized losses are estimated at $26,887,529 million. This hazard's CPRI probability is "**Highly Likely**" within a calendar year.

Hazard	Windstorm Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Vulnerability and Potential Losses by Jurisdiction

Methodology

To assess the vulnerability of each of Kansas's counties to wind events, the state assigned ratings to three factors that were examined at the county level: prior events, building exposure, and population density. The state then summed the ratings to obtain overall vulnerability scores for each county so that they could be compared and greatest vulnerability determined. The factors are described below.

Vulnerability Factors

Prior Events—This rating is based on the number of past wind events experienced by each county since 1950 according to data from the National Climatic Data Center's Storm Events database (a compilation of storm data from the National Weather Service). For the purposes of this plan, a wind event is considered thunderstorm winds or high winds as identified in the National Climatic Data Center's database that occurred between April 1 and September 30 in each of the given years (see the above description of the wind events that affect Kansas). (Data limitation: NCDC receives storm data from the National Weather Service (NWS), which receives information from a variety of sources, which include but are not limited to county, state, and federal emergency management officials, local law enforcement officials, Skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the general public. The wind events represent wind reports, not necessarily individual storms, and thus likely over count the actual number of windstorms.) To develop the prior event rating, the total range

of past occurrences (39 to 354) was divided into 10 roughly equal ranges as shown in Table 3.81. The ranges were numbered 1 through 10 in ascending order.

Table 3.81. Prior Event Ratings

# of Past Occurrences	Rating
0 - 44	1
45 – 81	2
82 – 118	3
119 - 155	4
156 - 192	5
193 - 229	6
230- 266	7
267 – 303	8
304 – 340	9
341– 374	10

Building Exposure—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

Population Density—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

A fourth factor, past wind damage, will be considered for the next plan update based on the availability of information. Currently, county-level damage information is not available for wind events. The damage values captured in the National Climatic Data Center's Storm Event database are for an entire storm and cannot be approximated for each individual county.

Total Windstorm Vulnerability

After rating each of the counties on the factors described above, the three factor ratings were added together to produce a county-level vulnerability rating. The highest possible total vulnerability rating was 30. The total range of vulnerability (3 to 25) was divided into three roughly equal ranges as shown in Table 3.82. The ranges were assigned a corresponding level of wind vulnerability: moderate, high, and very high.

Table 3.82. Windstorm Vulnerability

Windstorm Vulnerability Range	Windstorm Vulnerability
3 – 9	Moderate
10 – 17	High
18 – 25	Very High

Results
Vulnerability Factors

Summary of Prior Event Ratings—The lowest number of recorded wind events over this 55-year period was 39 in Linn County; the highest was 374 in Sedgwick County. All counties in Kansas experienced at least 39 wind events in the past 60 year. Only Sedgwick received a rating of 10. Eighty-seven percent of the counties received ratings between 1 and 3. Ratings of 1 and 2 were the most common, with 30 and 38% of counties respectively. The counties that received a prior event rating greater than 3 are shown in Table 3.83.

Table 3.83. Counties with Prior Event Ratings Greater Than 3

County	# of Prior Events	Prior Event Rating
Sedgwick	374	10
Sherman	357	9
Finney	350	8
Ford	325	8
Shawnee	323	8
Reno	312	7
Sumner	307	7
Cowley	301	7
Russell	283	7
Johnson	259	6
Barton	247	6
Butler	246	6
Lyon	230	5
Douglas	191	4

A spreadsheet that includes the corresponding values can be found in Appendix I Kansas Windstorm Vulnerability.

Summary of Building Exposure Event Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

A spreadsheet that includes the corresponding values can be found in Appendix I Kansas Windstorm Vulnerability.

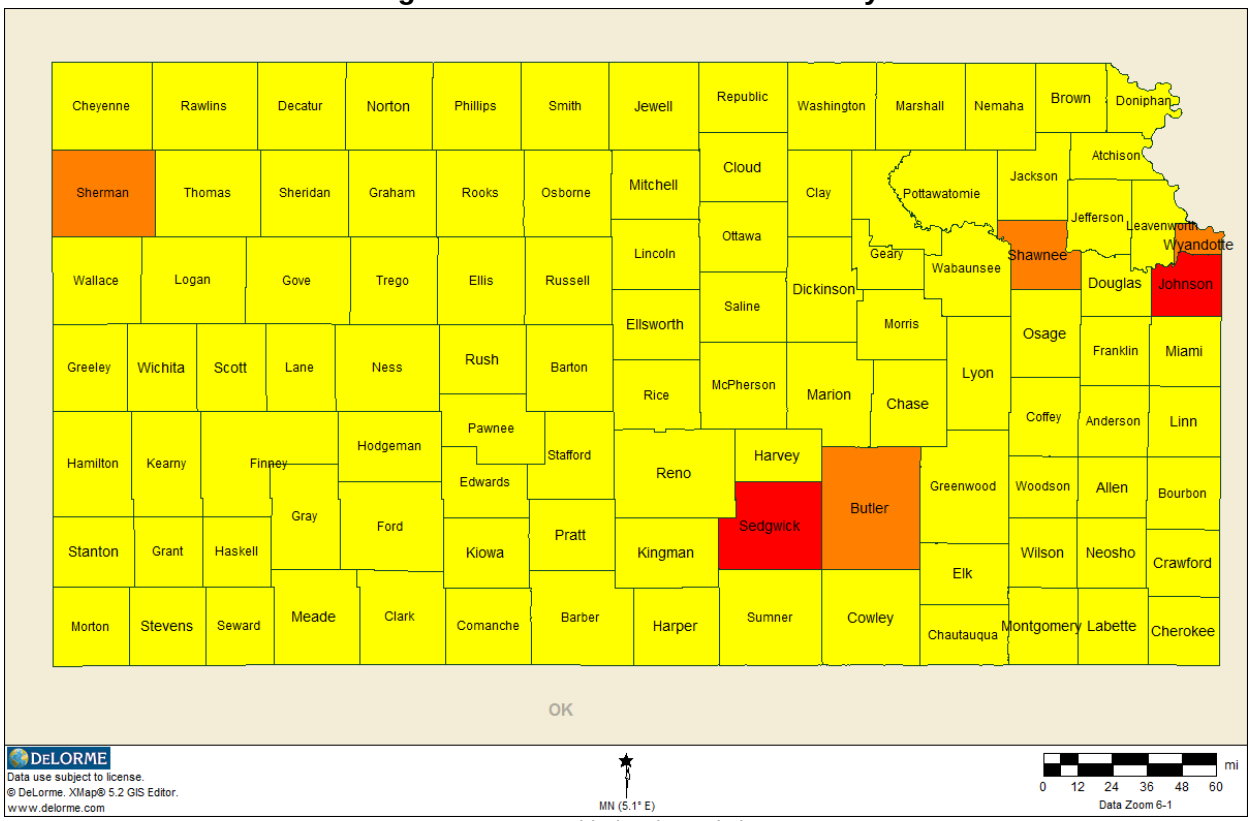
Summary of Population Density Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

A spreadsheet that includes the corresponding values can be found in Appendix I Kansas Windstorm Vulnerability.

Total Windstorm Vulnerability and Estimate of Potential Loss

According to this methodology, while every county in Kansas is vulnerable to wind, only Johnson and Sedgwick have very high vulnerabilities. Wyandotte, Shawnee, Sherman and Butler Counties have high vulnerabilities. The remaining counties, 94%, have moderate vulnerabilities. Figure 3.75 illustrates the vulnerability of Kansas counties to windstorms, and Table 3.84 shows all the Kansas counties ranked by total windstorm vulnerability along with their three vulnerability factor ratings.

Figure 3.75. Windstorm Vulnerability



Source: Bold Planning Solutions

Table 3.84. Vulnerability of Kansas Counties to Windstorms (ranked by vulnerability)

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Total Vulnerability Score	Windstorm Vulnerability
Johnson	3	10	10	23	Very High
Sedgwick	10	8	5	23	Very High
Wyandotte	3	3	10	16	High
Shawnee	8	3	3	14	High
Butler	9	1	1	11	High
Cowley	9	1	1	11	High
Finney	9	1	1	11	High
Sherman	9	1	1	11	High
Sumner	9	1	1	11	High
Douglas	5	2	3	10	High
Ford	8	1	1	10	High
Reno	8	1	1	10	High
Russell	8	1	1	10	High
Leavenworth	5	2	2	9	Moderate
Barton	6	1	1	8	Moderate
McPherson	6	1	1	8	Moderate
Cloud	5	1	1	7	Moderate
Gray	5	1	1	7	Moderate
Harper	5	1	1	7	Moderate
Jefferson	5	1	1	7	Moderate
Lyon	5	1	1	7	Moderate
Neosho	5	1	1	7	Moderate
Osage	5	1	1	7	Moderate
Saline	5	1	1	7	Moderate
Cheyenne	4	1	1	6	Moderate
Dickinson	4	1	1	6	Moderate
Ellis	4	1	1	6	Moderate
Ellsworth	4	1	1	6	Moderate
Franklin	4	1	1	6	Moderate
Graham	4	1	1	6	Moderate
Kingman	4	1	1	6	Moderate
Lincoln	4	1	1	6	Moderate
Pawnee	4	1	1	6	Moderate
Pottawatomie	4	1	1	6	Moderate
Rice	4	1	1	6	Moderate
Riley	4	1	1	6	Moderate
Seward	4	1	1	6	Moderate
Thomas	4	1	1	6	Moderate
Barber	3	1	1	5	Moderate
Bourbon	3	1	1	5	Moderate
Brown	3	1	1	5	Moderate
Chautauqua	3	1	1	5	Moderate
Cherokee	3	1	1	5	Moderate
Clark	3	1	1	5	Moderate
Clay	3	1	1	5	Moderate

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Total Vulnerability Score	Windstorm Vulnerability
Coffey	3	1	1	5	Moderate
Crawford	3	1	1	5	Moderate
Decatur	3	1	1	5	Moderate
Edwards	3	1	1	5	Moderate
Grant	3	1	1	5	Moderate
Greenwood	3	1	1	5	Moderate
Hamilton	3	1	1	5	Moderate
Harvey	3	1	1	5	Moderate
Haskell	3	1	1	5	Moderate
Hodgeman	3	1	1	5	Moderate
Kearny	3	1	1	5	Moderate
Kiowa	3	1	1	5	Moderate
Labette	3	1	1	5	Moderate
Marshall	3	1	1	5	Moderate
Miami	3	1	1	5	Moderate
Mitchell	3	1	1	5	Moderate
Montgomery	3	1	1	5	Moderate
Morris	3	1	1	5	Moderate
Nemaha	3	1	1	5	Moderate
Ness	3	1	1	5	Moderate
Norton	3	1	1	5	Moderate
Osborne	3	1	1	5	Moderate
Ottawa	3	1	1	5	Moderate
Pratt	3	1	1	5	Moderate
Rawlins	3	1	1	5	Moderate
Republic	3	1	1	5	Moderate
Scott	3	1	1	5	Moderate
Sheridan	3	1	1	5	Moderate
Smith	3	1	1	5	Moderate
Stafford	3	1	1	5	Moderate
Stanton	3	1	1	5	Moderate
Wabaunsee	3	1	1	5	Moderate
Wallace	3	1	1	5	Moderate
Allen	2	1	1	4	Moderate
Atchison	2	1	1	4	Moderate
Chase	2	1	1	4	Moderate
Comanche	2	1	1	4	Moderate
Doniphan	2	1	1	4	Moderate
Elk	2	1	1	4	Moderate
Geary	2	1	1	4	Moderate
Gove	2	1	1	4	Moderate
Greeley	2	1	1	4	Moderate
Jackson	2	1	1	4	Moderate
Jewell	2	1	1	4	Moderate
Lane	2	1	1	4	Moderate
Logan	2	1	1	4	Moderate

County	Prior Event Rating	Building Exposure Rating	Population Density Rating	Total Vulnerability Score	Windstorm Vulnerability
Marion	2	1	1	4	Moderate
Meade	2	1	1	4	Moderate
Morton	2	1	1	4	Moderate
Phillips	2	1	1	4	Moderate
Rooks	2	1	1	4	Moderate
Rush	2	1	1	4	Moderate
Stevens	2	1	1	4	Moderate
Trego	2	1	1	4	Moderate
Washington	2	1	1	4	Moderate
Wilson	2	1	1	4	Moderate
Woodson	2	1	1	4	Moderate
Anderson	1	1	1	3	Moderate
Linn	1	1	1	3	Moderate
Wichita	1	1	1	3	Moderate

To estimate potential losses to wind, historic loss data was analyzed. The National Climatic Data Center data did not lend itself to county by county loss summaries, only a statewide summary. Based on historic loss information presented in the wind hazard profile Kansas averages 218 wind events, $25 million in wind losses, and approximately five injuries each year.

Development in Hazard-Prone Areas

Any new development will be vulnerable to wind storm impacts. Building codes can help minimize impacts to new structures.

3.3.22 Winter Storm

Calculated Priority Risk Index	Hazard Ranking	Planning Significance
3.30	4 of 22	**High**

Description

Winter storms in Kansas usually come in the form of heavy snow or freezing rain (ice storms). Regardless of the form they take, they can have significant impacts to the state and its residents for days, weeks, or even months. They can immobilize a region, blocking roads and railways and closing airports, which can disrupt emergency and medical services, hamper the flow of supplies, and isolate homes and farms, possibly for days. Heavy snow can collapse roofs and knock down trees and power lines. Unprotected livestock may be lost. Economic impacts include cost of

snow removal, damage repair, business and crop losses, and power failures. It is these impacts that Kansas is most concerned about.

A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures (see Section 3.3.6 Extreme Temperatures). The National Weather Service describes different types of winter storm events as follows:

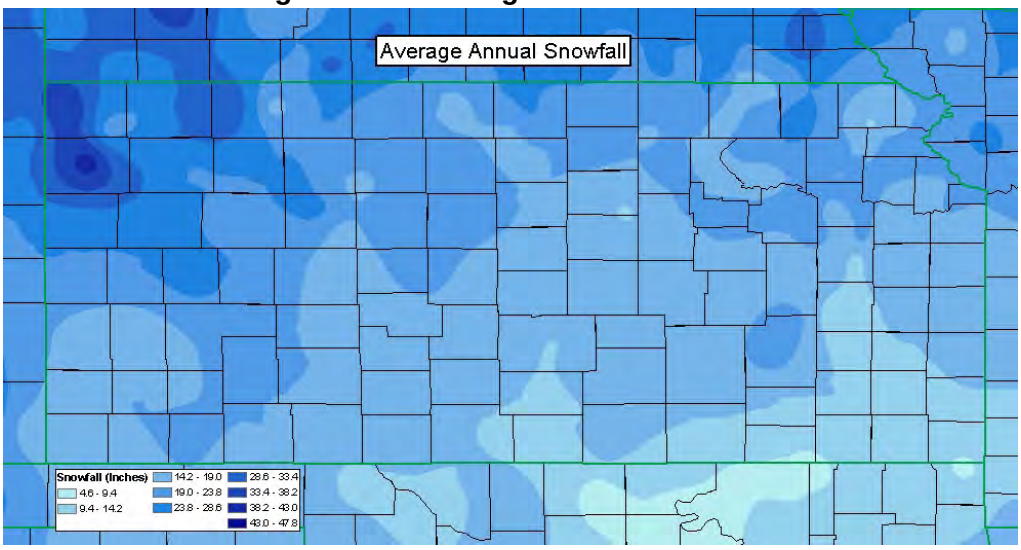
- **Blizzard**—Winds of 35 mph or more with snow and blowing snow reducing visibility to less than 1/4 mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- **Snow Showers**—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- **Freezing Rain**—Measurable 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 coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
- **Sleet**—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Heavy accumulations of ice, often the result of freezing rain, can bring down trees, utility poles, and communications towers and disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians.

Location

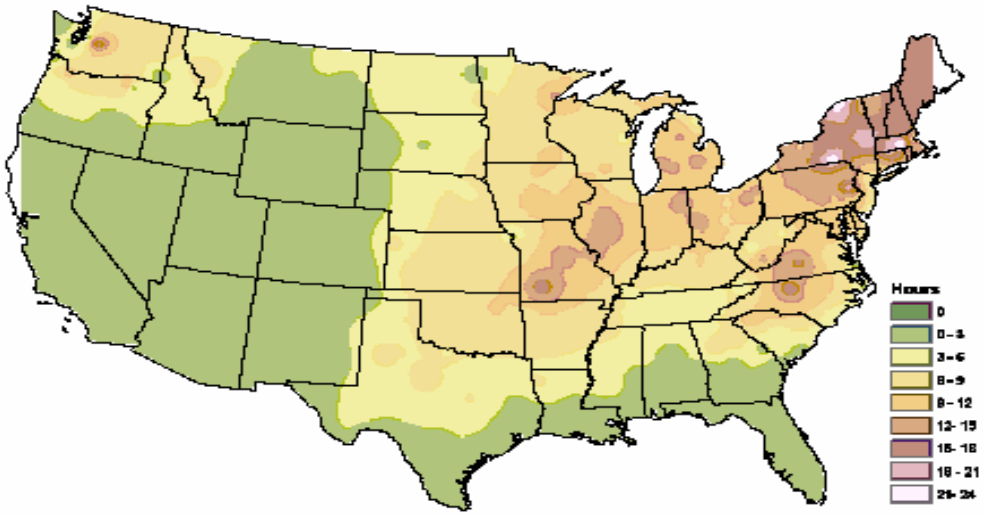
The entire State of Kansas is vulnerable to heavy snow and freezing rain. Northwestern Kansas receives the greatest average annual snowfall and the southeast receives the least (see Figure 3.76). Freezing rains occurs most frequently in southeastern Kansas and least frequently in western Kansas (see Figure 3.77).

Figure 3.76. Average Annual Snowfall



Source: Kansas State University, Research and Extension, Weather Data Library, www.oznet.ksu.edu/wdl/Maps/Climatic/AnnualFreezeMap.asp

Figure 3.77. Average Number of Hours per Year with Freezing Rain in the United States



Source: American Meteorological Society. "Freezing Rain Events in the United States." http://ams.confex.com/ams/pdfpapers/71872.pdf.

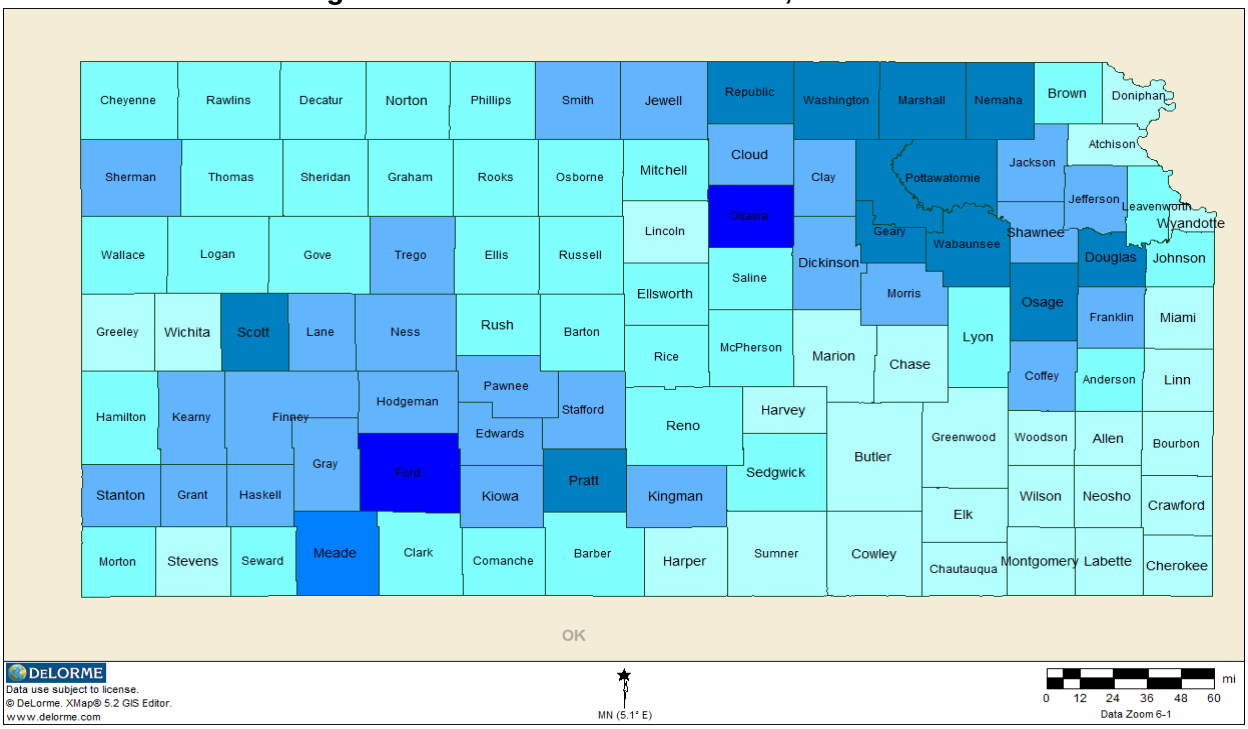
More information about location can be found in the Previous Occurrences and Vulnerability and Potential Losses by Jurisdiction sections.

Previous Occurrences

Table 3.20 contains more detailed information about the counties that were included in presidential declarations.

According to the National Climatic Data Center Storm Events database, there were 807 winter storms (snow and ice events) in Kansas between 1993 and 2010. Total property damage for these events is estimated at just under $308 million. This suggests that Kansas experiences 47 winter storms and $18.1 million in winter storm losses each year. There were 47 deaths and 117 injuries in this time period, which averages out to approximately 3 deaths and 7 injuries each year.

Figure 3.78. Kansas Winter Storms, 1993–2010



Source: Bold Planning Solutions

- **75 – 88 Events**
- **59 – 74 Events**
- **43 – 58 Events**
- **27 – 42 Events**
- **11 – 26 Events**

FEMA-1868-DR—December, 2009

On December 10, 2009, Governor Mark Parkinson requested a major disaster declaration because of a severe winter storm during the period of November 14-16, 2009. The governor requested a Declaration for Public Assistance for three counties and hazard mitigation statewide. During the period of December 1-5, 2009, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments, and that federal assistance is necessary.

FEMA-1741-DR—February, 2008

On January 22, 2008, Governor Kathleen Sebelius requested a major disaster declaration because of severe winter storms during the period of December 6-19, 2007. The governor requested a Declaration for Public Assistance, including direct federal assistance, for 60 counties and hazard mitigation for all counties. Beginning on December 28, 2007, through January 16, 2008, joint federal, state, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the

capabilities of the state and the affected local governments, and that federal assistance is necessary**.**

FEMA-1675-DR—January 7, 2007 (December 28–30)
This storm was one of Kansas' worst disasters on record. It began on December 28, 2006, and increased in intensity December 29 overnight into December 30. Snow depths ranged from four inches in Saline County to 30 inches in Wallace County. Several counties set snowfall records. Numerous highways were closed for days in western Kansas, and there were major power outages because of icing. During the peak of the storm there were 46,300 meters off-line and 10,500 power poles down. Approximately 60,000 people were without power. There were three storm-related fatalities.

The storm also severely impacted ranchers, making it temporarily impossible for some to feed and water livestock. The Kansas National Guard used Black Hawk helicopters to feed stranded cattle.

FEMA-1626-DR—January 26, 2006 (November 27-28, 2005)
Much of the state was affected by this storm. Winds of 40 to 60 mph combined with two to seven inches of snow resulted in a blizzard, which raged across parts of north central Kansas. The wind whipped the snow into drifts 10 to 15 feet high in some places. Interstate 70 was closed west of Russell, and numerous other highways were impassable during the storm. There were several reports of auto accidents, including a 25-car pileup, and sporadic power outages. At least three auto-related deaths were attributed to the storm.

FEMA-1579-DR—February 8, 2005 (January 4-6)
This was one of the worst ice storms on record to hit central, south-central, and southeast Kansas. Although freezing rain was the primary culprit, sleet also played a vital role in coating nearly the entire region with one-two inches of ice, which caused incredible damage to trees, power lines, and power poles. Roads and highways were blocked by tree debris and downed power poles and lines. Many areas were without power for more than a week. Between three and five inches of snow accumulated in Russell, Lincoln, and Saline Counties. The storm caused an estimated $30 million damage. Particularly hard hit were Butler and Sedgwick Counties, which sustained an estimated $8.5 million and $15 million damage, respectively. Three deaths were attributed to the storm.

FEMA-1402-DR: Ice Storm—February 6, 2002 (January 29–February 15)
Beginning on January 29, a three-day severe winter storm hit 35 Kansas counties in the southeast corner of the state with freezing rain, drizzle, sleet, and snow. With one to two inches of ice accumulation, utility poles and power lines snapped, transportation was treacherous, and fallen trees damaged many structures. The resulting power outages affected nearly the entire region and lasted nearly a week in some areas. Loss of power was particularly problematic for many nursing homes. There were seven casualties, and property damage approximated $32 million. This was the worst ice storm in Kansas City history.

Other Notable Winter Storms

- December 22, 2009 - Freezing drizzle and fog resulted in slick roads, numerous traffic accidents and slide offs on Interstate 70. Two fatalities and three injuries occurred in two of the more severe accidents occurring between 2100 and 2200 CST. Property damage noted is related only to the fatality/injury accidents.

- November 16, 2009 - A slow moving storm system produced six to twelve inches of heavy wet snow across parts of Northeast Kansas. The heaviest snow and greatest impact occurred along and north of a Concordia to Hiawatha line where numerous power outages because of downed power lines were reported. Very little in the way of snowfall accumulation occurred south of this line since air temperatures were in the low to middle 30s and the significant accumulation occurred in areas of heavy precipitation while other areas that received snow saw it melt as it fell. Damage estimates of 1.6 million dollars included damage to power poles across Washington, Marshall, Republic and Cloud Counties with the worst damage across Washington and Marshall Counties.
- December 9, 2008 - One to three inches of snow fell across portions of the county leading to numerous traffic accidents. Over 650 traffic accidents were reported in and an around the Greater Wichita area during the morning commute, with 36 injuries reported. One accident of note was a five to six car pileup near Park City along Interstate 135.
- December 10, 2007 - A devastating freezing rain event unfolded across parts of Southern and Central Kansas from December 10th through the 11th. At the same time, an Arctic air mass was moving south into the Central Plains, and a mid and upper level storm system was spinning in the Four Corners area. This storm system allowed for very warm and very moist conditions to override the Arctic air. The result was a very large swath of freezing rain, which in some areas approached two inches thick. The weight of the ice encrusting everything, which adds nearly two tons of weight to a typical line span, resulted in thousands of downed power poles and tens of thousands of downed power lines. This naturally resulted in tens of thousands of Central and Southern Kansas residents losing power, some for more than a week. Some estimates place the number without power at one point was nearly 200 thousand across the state. An unknown number of trees were damaged or destroyed in the ice storm with some cities reporting more than 80% of trees sustaining some form of damage. Damage to just the electric infrastructure topped $100 million. Damage to trees added millions more to the final tally.
- December 28 - 31, 2006 (FEMA-1675-DR) –-- A county sheriff and State Project Officer Cecily Jimenez inspected one of numerous communications towers that were knocked out during the winter snow and ice storms The storms left up to 30 inches of snow and 1/4 inch of ice on guide wires that brought several towers down.
  Affected Counties included: Cheyenne, Clark, Comanche, Decatur, Edwards, Ellis, Finney, Ford, Gove, Graham, Grant, Gray, Greeley, Hamilton, Haskell, Hodgeman, Jewell, Kearny, Kiowa, Lane, Logan, Meade, Morton, Ness, Norton, Osborne, Pawnee, Phillips, Rawlins, Rooks, Rush, Russell, Scott, Seward, Sheridan, Sherman, Smith, Stafford, Stanton, Stevens, Thomas, Trego, Wallace, Wichita Counties.
- November 29–December 1, 2006—A winter storm produced a period of freezing precipitation and sleet in east central Kansas on November 29 followed by snowfall of six to ten inches on the 30th through the early morning of December 1. Counties that were hit particularly hard include Franklin, Anderson, Coffey, Osage, Lyon, and Douglas. The storm also affected southeast Kansas where snowfall amounts exceeded 12 inches in some locations and almost paralyzed the area for a couple of days.
- March 20, 2006—A major late winter storm brought 12 to 14 inches of snow to most of the northwest counties. Portions of southwest Kansas received 8 to 10 inches of snow.
- January 25-26, 2004—A wintry mix of freezing rain, sleet, and snow fell across north-central, northeast, and east-central Kansas. Ice accumulations of 1/4 to 1/2 of an inch were reported across northeast and parts of east-central Kansas. The ice built up on trees and power lines and caused numerous power outages and downed limbs across north-central and northeast

Kansas. Slick roads led to numerous accidents across the region. Strong winds on the 26th caused near whiteout conditions as the snow blew and drifted.

- February 8-9, 2001—Freezing rain and sleet fell across central and portions of south-central Kansas (mainly west of Wichita). For those locations from Wichita eastward, surface temperatures above freezing allowed the precipitation to initially fall as rain. The ice in central and portions of south-central Kansas changed to snow, and the rain in south-central Kansas changed to sleet and freezing rain. Many locations reported one-half inch of ice accumulation resulting in treacherous driving conditions and downed trees and power lines.
- January 27-28, 2001—Heavy snow fell in central Kansas west of Arlington and Marquette to Glendale, where accumulations ranged from six to twelve inches. An isolated area of 14 inches was reported in Barton County, in Hoisington and Hetzer. A mixture of snow, sleet, and freezing rain fell over south-central Kansas, which changed to primarily sleet and freezing rain, causing ice accumulations on trees, overpasses, power lines, and other elevated, exposed surfaces. Numerous vehicle accidents and scattered power outages were reported across south-central and portions of southeastern Kansas.
- January 2000—An ice storm caused two major traffic accidents on Kansas' interstate highways that killed two and injured two others.
- January 1999—An ice storm caused almost $2 million in property damage. Damage to trees and power lines was extensive, resulting in widespread power outages and dangerous roadway conditions.
- March 1998—A blizzard dumped at least six inches of snow northwest of the Kansas Turnpike. Numerous accidents and stranded cars were reported. One fatal accident occurred in Dickinson County. Wind-caused drifts of four to seven feet were common, with some drifts exceeding 10 feet.
- 1998—An ice storm caused significant property damage and traffic accidents, which resulted in injuries and fatalities.
- Fall 1997—An autumn snowstorm surprised north central Kansas with wind driven snow depths in excess of one foot. Many roads west of Smith Center and Osborne became impassable at the height of the storm. As much as 15 inches paralyzed some areas, causing a roof of an auto dealership in Smith Center to collapse. Schools and businesses were closed for several days.
- 1997—A significant storm resulted in a fatal traffic accident as well as significant property damage.
- October 1996— Record-setting snowfall knocked out power to an estimated 60,000 customers. Property damage was estimated at $500,000.
- 1989—A blizzard struck western Kansas and a second one struck Goodland with 50 mph winds and massive drifts. Thousands of animals were killed and 30-foot drifts were recorded in northwest Kansas.
- 1987—A blizzard hit western Kansas and 78 mph winds were recorded in Dodge City.
- March 18, 1984—Freezing rain, accompanied by lightning and thunder, accumulated to around an inch thick on trees, power lines, roads, and all exposed surfaces around Topeka. The heavy weight of the ice knocked out power to an estimated 100,000 people, most of the city of Topeka. A large television transmission tower collapsed under the weight of the ice, along with many trees and large tree branches. Destruction was widespread throughout the city. It was believed to be the most damaging ice storm in the city's history. Electricity was not restored in some areas for over a week.
- December 1978—Major ice storm
- January 1974—Major ice storm

- February 21, 1971—An intense winter storm buried southern Kansas with 10-13 inches of snow. Gusty north-northeast winds produced near zero visibility, bringing a large portion of southern Kansas to a standstill.
- 1922—Dodge City received 17.5 inches of snow in 24 hours.
- 1911-1912—Beginning in late 1911 and continuing through March 1912, frequent bouts of snow and very cold temperatures pounded the Topeka area. Nearly 48 inches of snow fell that winter. The March snowfall alone totaled 26.2 inches. The blizzard of February 25-26 left 10-foot snow drifts, paralyzed the city, cut rail traffic for days, and killed many cattle.

Table 3.85 lists Kansas snowfall and snow depth extremes from the National Data Climatic Center.

Table 3.85. Kansas Snowfall and Snow Depth Extremes

	Snow Amount (inches)	County	Ending Date	Number of Years of Non-Missing Data	Data Period Analyzed
Greatest Daily Snowfall	25.0	Cherokee	03/14/1896	111	1892–2009
Greatest 2-Day Snowfall (Snowed Both Days)	37.0	Johnson	03/24/1912	99	1894–2009
Greatest 3-Day Snowfall (Snowed All 3 Days)	33.0	Morton	02/26/1903	94	1900–2009
Greatest 4-Day Snowfall (Snowed All 4 Days)	30.5	Stanton	12/20/1918	65	1894–1981
Greatest 5-Day Snowfall (Snowed All 5 Days)	29.0	Stanton	11/06/1946	64	1894–1981
Greatest 6-Day Snowfall (Snowed All 6 Days)	30.0	Rawlins	04/02/1980	52	1954–2009
Greatest 7-Day Snowfall (Snowed All 7 Days)	35.0	Rawlins	04/02/1980	52	1954–2009
Greatest Monthly Snowfall Total	55.9	Johnson	03/1912	89	1894–2009
Greatest Aug-July Snowfall Total	103.6	Rawlins	1984	25	1954–2009
Greatest Daily Snow Depth	31.0	Jackson	03/16/1960	45	1902–2009

Source: National Data Climatic Center Snow Climatology, www.ncdc.noaa.gov/ussc/
Note: Missing data may cause apparent discrepancies among the daily extreme, monthly total, and seasonal total snowfall values. The monthly and seasonal totals were based on complete data; if any days were missing, then the monthly or seasonal total could not be computed for that year. Daily snowfall extremes were not as susceptible to missing data. Consequently, it may be possible for a one-day extreme to be greater than a multiple-day extreme, a daily extreme to be greater than a monthly total, and a monthly total to be greater than a seasonal total. Checking the "number of years with non-missing data" parameter is an important part of using this snow climatology.

Probability

According to the National Climatic Data Center Storm Events database, there were 807 winter storms (snow and ice events) in Kansas between 1993 and 2010 (17 years). Based on this

information, the probability that at least one winter storm will occur in Kansas in any given year is 100%. Kansas can expect approximately $181 million in winter storm losses each year. This hazard's CPRI probability is "**Highly Likely**" within a calendar year.

Hazard	Winter Storm Event	Y	N
4 - Highly Likely	Event is probable within the calendar year	x	
	Event has up to 1 in 1 year chance of occurring (1/1=100%)	x	
	History of events is greater than 33% likely per year	x	
	Event is "Highly Likely" to occur	x	
3 - Likely	Event is probable within the next three years		x
	Event has up to 1 in 3 years chance of occurring (1/3=33%)		x
	History of events is greater than 20% but less than or equal to 33% likely per year		x
	Event is "Likely" to occur		x
2 - Possible	Event is probable within the next five years		x
	Event has up to 1 in 5 years chance of occurring (1/5=20%)		x
	History of events is greater than 10% but less than or equal to 20% likely per year		x
	Event could "Possibly" occur		x
1 - Unlikely	Event is possible within the next 10 years		x
	Event has up to 1 in 10 years chance of occurring (1/10=10%)		x
	History of events is less than or equal to 10% likely per year		x
	Event is "Unlikely" but is possible to occur		x

Local Plan Integration

For the 2010 update the committee reviewed all of the FEMA-approved local plans in the State of Kansas. The data gathered from the local plans can be found in Table 3.86.

Table 3.86.Local Plan Statistics for Winter Storm Events

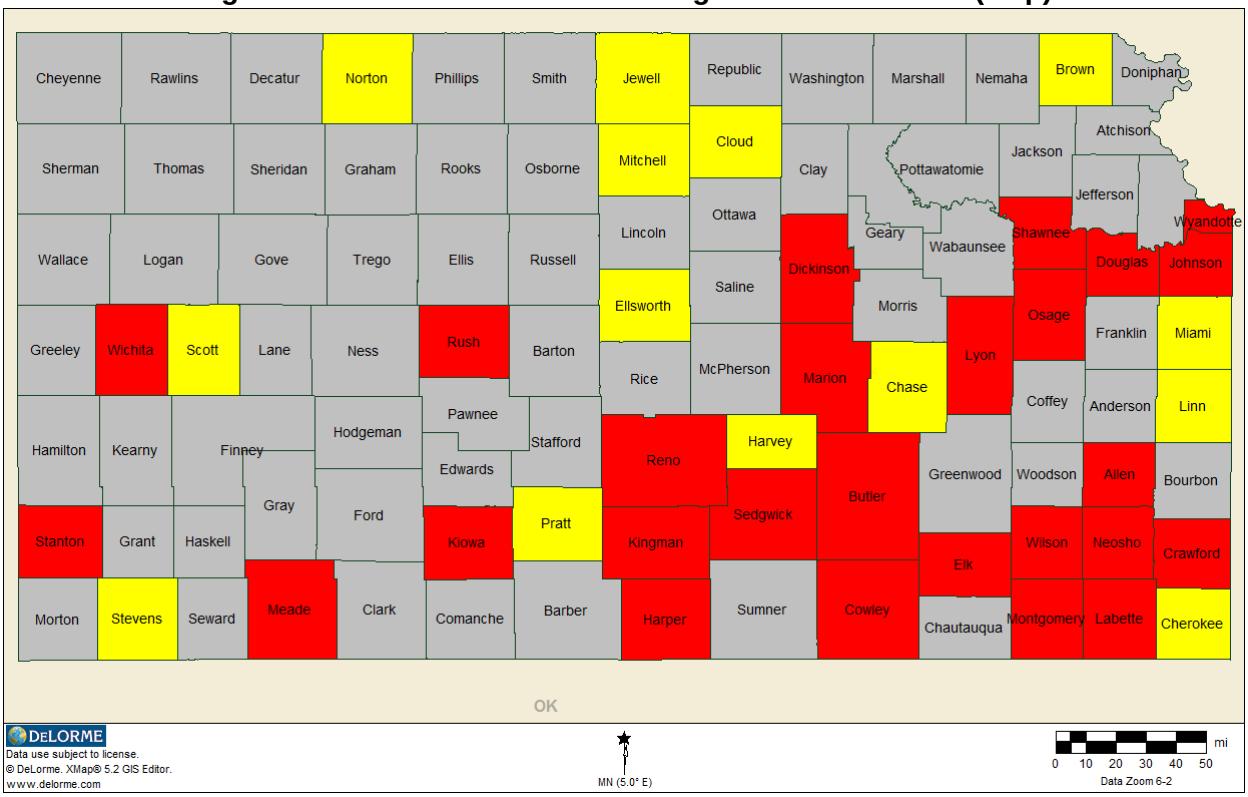
County	Hazard Ranking	# of Events	Damages (Prop)	Damages (Crop)	Injuries	Fatalities
Allen	High	14	$365,000.00	$1,513,305.00	N/A	N/A
Brown	Moderate	38	$8,000,000.00	N/A	8	2
Butler	High	26	$48,890,000.00	N/A	17	4
Chase	Moderate	14	$46,864,000.00	N/A	N/A	N/A
Cherokee	Moderate	16	N/A	N/A	N/A	N/A
Cloud	Moderate	52	$14,665,000.00	N/A	N/A	N/A
Cowley	High	3	N/A	N/A	N/A	N/A
Crawford	High	21	N/A	N/A	N/A	N/A
Dickinson	High	49	N/A	N/A	N/A	2
Douglas	High	62	N/A	N/A	N/A	N/A
Elk	High	21	N/A	$246,732.00	N/A	N/A
Ellsworth	Moderate	29	$40,820,000.00	N/A	2	3
Harper	High	17	N/A	$17,469,574.00	N/A	N/A
Harvey	Moderate	23	N/A	$8,332,640.00	N/A	N/A
Jewell	Moderate	45	$4,275,000.00	$500,000.00	4	N/A
Johnson	High	29	$24,474,429.00	$154,041.00	N/A	N/A
Kingman	High	47	$17,000,000.00	N/A	N/A	N/A
Kiowa	High	49	N/A	N/A	N/A	N/A
Labette	High	14	N/A	$1,912,015.00	N/A	N/A
Linn	Moderate	11	$9,771,028.00	N/A	N/A	N/A
Lyon	High	42	$18,184,000.00	N/A	47	13
Marion	High	N/A	N/A	N/A	N/A	N/A
Meade	High	N/A	N/A	N/A	N/A	N/A
Miami	Moderate	26	$9,519,946.00	N/A	N/A	N/A
Mitchell	Moderate	27	N/A	N/A	N/A	N/A
Montgomery	High	17	$2,841,883.00	$1,741,691.00	N/A	N/A
Neosho	High	20	N/A	$1,102,092.00	N/A	N/A
Norton	Moderate	33	$35,000.00	N/A	7	1
Osage	High	63	$18,098,000.00	$653,277.00	47	16
Pratt	Moderate	N/A	N/A	N/A	N/A	N/A
Reno	High	N/A	N/A	$13,317,190.00	N/A	N/A
Rush	High	30	N/A	$1,395,605.00	N/A	N/A
Scott	Moderate	N/A	N/A	N/A	N/A	N/A
Sedgwick	High	27	$49,000,000.00	N/A	18	5
Shawnee	High	43	N/A	N/A	N/A	N/A
Stanton	High	49	$2,600,000.00	$1,745,541.00	1	3
Stevens	Moderate	15	$2,630,996.00	N/A	N/A	N/A
Wichita	High	25	N/A	N/A	N/A	N/A
Wilson	High	16	N/A	$1,642,711.00	N/A	N/A
Wyandotte	High	20	N/A	N/A	N/A	N/A
Totals		**1033**	**$318,034,282.00**	**$51,726,414.00**	**151**	**49**

After reviewing the data from the local plans throughout the State of Kansas the committee calculated averages for winter storms, as shown in the table below. The state can expect an average of $357,948 in damages from a single winter storm event. An annual average calculation was not used because not all plans use the same period of data, therefore an annual average would not be accurate.

Table 3.87.Local Plan Statistics for Lightning Events

	Deaths	Injuries	Total Damages
Totals	49	151	$369,760,696
Average per County	1.225	3.775	$9.244,017
Average Per Event	0.05	0.14	$357,948

Figure 3.79.Local Plan Hazard Rating for Winter Storms (Map)



Source: Bold Planning Solutions

Red – High Risk – 26 Jurisdictions
Yellow – Moderate Risk – 14 Jurisdictions
Gray – No Plan / Rating – 65 Jurisdictions

Vulnerability and Potential Losses by Jurisdiction

Methodology

All counties in Kansas are vulnerable to winter storms to some degree, with the overall significance of the hazard considered high by the KHMT. To assess the relative vulnerability of each of Kansas's counties to winter storms, the state assigned ratings to three factors that were examined at the county level: prior events, building exposure, and population density. The state then summed the ratings to obtain overall vulnerability scores for each county so that they could be compared and greatest relative vulnerability determined. The factors are described below.

Vulnerability Factors

Prior Events—This rating is based on the number of past winter storms experienced by each county between 1993 and 2010 according to data from the National Climatic Data Center's Storm Events database (a compilation of storm data from the National Weather Service). The database does not have information for winter storms prior to 1993. Although the University of South Carolina Hazards and Vulnerability Research Institute's Spatial Hazard Events and Losses Database for the United States (SHELDUS) has events from 1963-2005, it only includes those events for which damage was reported, thus it is not as comprehensive as the National Climatic Data Center.

To develop the prior event rating, the total range of past occurrences (11 to 88) was divided into 10 roughly equal ranges as shown in Table 3.88. The ranges were numbered 1 through 10 in ascending order.

Table 3.88. Prior Event Ratings

# of Past Occurrences	Rating
11 – 18	1
19 – 26	2
27 – 34	3
35 - 42	4
43 – 50	5
51 – 58	6
59 – 66	7
67 – 74	8
75 – 82	9
83 - 88	10

Building Exposure—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

Population Density—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction

A fourth factor, past winter storm damage, will be considered for the next plan update based on the availability of information. Currently, county-level damage information is not available for winter storms. The damage values captured in the National Climatic Data Center's Storm Event database are for an entire event and cannot be approximated for each individual county.

Total Winter Storm Vulnerability

After rating each of the counties on the factors described above, the three factor ratings were added together to produce a county-level vulnerability rating. The highest possible total vulnerability rating was 30. The total range of vulnerability (3 to 23) was divided into three equal ranges as shown in Table 3.89. The ranges were assigned a corresponding level of winter storm vulnerability: moderate, high, and very high. The vulnerability scale begins at moderate as every county has some degree of vulnerability.

Table 3.89. Winter Storm Vulnerability

Winter Storm Vulnerability Range	Winter Storm Vulnerability
3 - 9	Moderate
10 - 17	High
18 - 23	Very High

Results
Vulnerability Factors

Summary of Prior Event Ratings—The lowest number of recorded winter storms over this 17-year period was 11 in Linn County; the highest was 88 in Ford County. All counties in Kansas experienced at least 10 winter storms in the past 17 years. Two counties received a rating of 10: Ford and Ottawa. The counties that received a prior event rating greater than seven are shown in Table 3.90.

Table 3.90. Counties with Prior Event Ratings Greater Than 7

County	# of Events	Prior Events Rating
Ford	88	10
Ottawa	85	10
Geary	67	8
Marshall	67	8
Nemaha	67	8
Wabaunsee	65	7
Pottawatomie	64	7
Osage	63	7
Washington	63	7
Douglas	62	7
Riley	60	7
Republic	59	7

A spreadsheet that includes the corresponding values can be found in Appendix J Kansas Winter Storm Vulnerability.

Summary of Building Exposure Event Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction.

A spreadsheet that includes the corresponding values can be found in Appendix J Kansas Winter Storm Vulnerability.

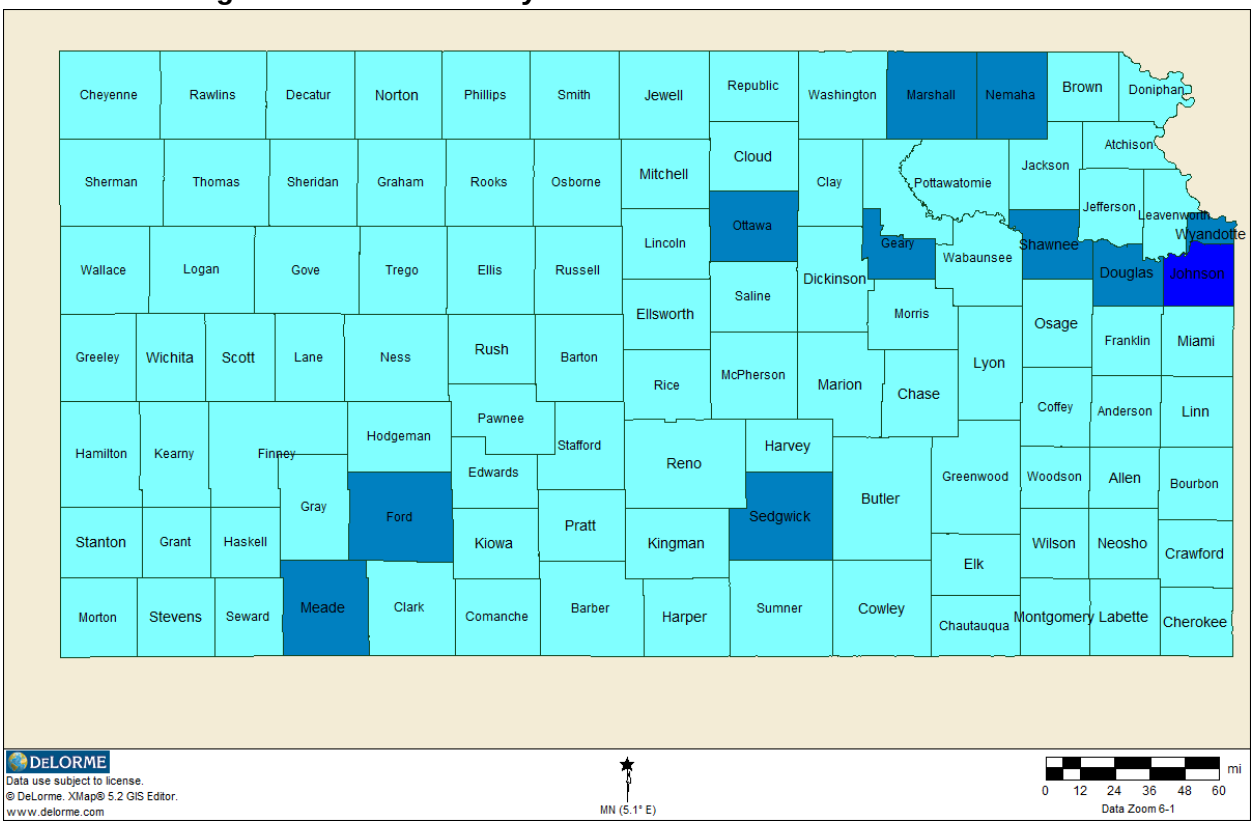
Summary of Population Density Ratings—See Section 3.3.9 Hailstorm, Vulnerability and Potential Losses by Jurisdiction.

A spreadsheet that includes the corresponding values can be found in Appendix J Kansas Winter Storm Vulnerability.

Total Winter Storm Vulnerability and Estimate of Potential Loss

According to this methodology, while every Kansas county is vulnerable to winter storms, only Johnson has a very high vulnerability. Of the remaining counties, 9.5% have high vulnerabilities and 89.5% have moderate vulnerabilities. Figure 3.80 illustrates the vulnerability of Kansas counties to winter storms, and Table 3.91 lists all the Kansas counties ranked by total winter storm vulnerability along with their three vulnerability factor ratings.

Figure 3.80. Vulnerability of Kansas Counties to Winter Storms



Source: Bold Planning Solutions

– Very High Vulnerability

- High Vulnerability

- Moderate Vulnerability

Table 3.91. Vulnerability of Kansas Counties to Winter Storms (ranked by vulnerability)

County	Prior Events Rating	Building Exposure Rating	Population Density Rating	Total Vulnerability Rating	Vulnerability Rating
Johnson	3	10	10	23	Very High
Sedgwick	3	8	5	16	High
Wyandotte	2	3	10	15	High
Douglas	7	2	3	12	High
Ford	10	1	1	12	High
Ottawa	10	1	1	12	High
Shawnee	5	3	3	11	High
Geary	8	1	1	10	High
Marshall	8	1	1	10	High
Meade	8	1	1	10	High
Nemaha	8	1	1	10	High
Osage	7	1	1	9	Moderate
Pottawatomie	7	1	1	9	Moderate
Pratt	7	1	1	9	Moderate
Republic	7	1	1	9	Moderate
Riley	7	1	1	9	Moderate
Scott	7	1	1	9	Moderate
Wabaunsee	7	1	1	9	Moderate
Washington	7	1	1	9	Moderate
Clay	6	1	1	8	Moderate
Cloud	6	1	1	8	Moderate
Coffey	6	1	1	8	Moderate
Edwards	6	1	1	8	Moderate
Franklin	6	1	1	8	Moderate
Jackson	6	1	1	8	Moderate
Jefferson	6	1	1	8	Moderate
Morris	6	1	1	8	Moderate
Dickinson	5	1	1	7	Moderate
Finney	5	1	1	7	Moderate
Grant	5	1	1	7	Moderate

Gray	5	1	1	7	Moderate
Haskell	5	1	1	7	Moderate
Hodgeman	5	1	1	7	Moderate
Jewell	5	1	1	7	Moderate
Kearny	5	1	1	7	Moderate
Kingman	5	1	1	7	Moderate
Kiowa	5	1	1	7	Moderate
Lane	5	1	1	7	Moderate
Leavenworth	3	2	2	7	Moderate
Ness	5	1	1	7	Moderate
Pawnee	5	1	1	7	Moderate
Sherman	5	1	1	7	Moderate
Smith	5	1	1	7	Moderate
Stafford	5	1	1	7	Moderate
Stanton	5	1	1	7	Moderate
Trego	5	1	1	7	Moderate
Anderson	4	1	1	6	Moderate
Barber	4	1	1	6	Moderate
Brown	4	1	1	6	Moderate
Cheyenne	4	1	1	6	Moderate
Clark	4	1	1	6	Moderate
Comanche	4	1	1	6	Moderate
Decatur	4	1	1	6	Moderate
Ellis	4	1	1	6	Moderate
Graham	4	1	1	6	Moderate
Hamilton	4	1	1	6	Moderate
Lyon	4	1	1	6	Moderate
Morton	4	1	1	6	Moderate
Phillips	4	1	1	6	Moderate
Rawlins	4	1	1	6	Moderate
Rooks	4	1	1	6	Moderate
Seward	4	1	1	6	Moderate
Sheridan	4	1	1	6	Moderate
Thomas	4	1	1	6	Moderate
Barton	3	1	1	5	Moderate

Ellsworth	3	1	1	5	Moderate
Gove	3	1	1	5	Moderate
Logan	3	1	1	5	Moderate
McPherson	3	1	1	5	Moderate
Mitchell	3	1	1	5	Moderate
Norton	3	1	1	5	Moderate
Osborne	3	1	1	5	Moderate
Reno	3	1	1	5	Moderate
Rice	3	1	1	5	Moderate
Rush	3	1	1	5	Moderate
Russell	3	1	1	5	Moderate
Saline	3	1	1	5	Moderate
Wallace	3	1	1	5	Moderate
Atchison	2	1	1	4	Moderate
Bourbon	2	1	1	4	Moderate
Butler	2	1	1	4	Moderate
Chautauqua	2	1	1	4	Moderate
Cowley	2	1	1	4	Moderate
Crawford	2	1	1	4	Moderate
Doniphan	2	1	1	4	Moderate
Elk	2	1	1	4	Moderate
Greeley	2	1	1	4	Moderate
Greenwood	2	1	1	4	Moderate
Harvey	2	1	1	4	Moderate
Lincoln	2	1	1	4	Moderate
Marion	2	1	1	4	Moderate
Miami	2	1	1	4	Moderate
Neosho	2	1	1	4	Moderate
Sumner	2	1	1	4	Moderate
Wichita	2	1	1	4	Moderate
Woodson	2	1	1	4	Moderate
Allen	1	1	1	3	Moderate
Chase	1	1	1	3	Moderate
Cherokee	1	1	1	3	Moderate
Harper	1	1	1	3	Moderate

Labette	1	1	1	3	Moderate
Linn	1	1	1	3	Moderate
Montgomery	1	1	1	3	Moderate
Stevens	1	1	1	3	Moderate
Wilson	1	1	1	3	Moderate

To estimate potential losses to winter storms, historic loss data was analyzed. The National Climatic Data Center data did not lend itself to county by county loss summaries, only a statewide summary. According to the National Climatic Data Center Storm Events database, there were 807 winter storms (snow and ice events) in Kansas between 1993 and 2010. Total property damage for these events is estimated at just under $308 million. This suggests that Kansas experiences 47 winter storms and $181 million in winter storm losses each year. There were 47 deaths and 117 injuries in this time period, which averages out to approximately three deaths and seven injuries each year.

Development in Hazard-Prone Areas
Not a major factor for this hazard, as the entire state is prone to winter storms.

3.3.23 Section Summary

The information presented above indicates that statewide disaster events have had a substantial human and economic impact on the state, and are therefore important considerations for both state and local mitigation planning and programming. These events substantiate the need for continuing focus on hazards, particularly tornado, flood, major disease outbreak, winter storm, wildfire, and windstorm. The lessons learned from these events were considered by the KHMT and its participating agencies for development of the state's mitigation strategy and proposed mitigation actions and enhancements to current mitigation programming. Local mitigation planning groups are also encouraged to review the lessons learned from these statewide events in the continuing development of their local mitigation plans.

Appendix K Risk Assessment Summary contains a summary of the planning significance and major issues associated with each hazard for quick reference.

3.4 State Facilities: Vulnerability and Potential Losses

IFR REQUIREMENT 201.4(c)(2)(ii):	[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2) based on estimates provided in the State risk assessment State owned critical or operated facilities located in the identified hazard areas shall also be addressed ...
Explanation:	The plan **shall** describe the State-owned or operated buildings, infrastructure, and critical facilities located in areas subject to hazards described previously. The description *should* include the uses, approximate sizes, types, and values of buildings, infrastructure, and critical facilities.
IFR REQUIREMENT 201.4(c)(2)(iii):	[The State risk assessment shall include an overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in] the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas. .
Explanation:	This requires States to estimate losses to State-owned or operated facilities and infrastructure. The plan **shall** describe the distribution of losses across the State, with specific reference to quantifying losses to critical facilities. States *should* also describe their approach for determining losses for State-owned infrastructure and buildings.
Update	If there are changes to the hazard profile and/or to the State facilities and infrastructure as described under Assessing Vulnerability of State Facilities, this section **must** be updated to reflect potential losses to identified vulnerable structures and infrastructure. If the approach for determining these losses has changed since the first approval, the plan *should* describe the new methodology.

This section addresses the vulnerability and potential loss to state-owned or operated critical facilities and infrastructure from the identified hazards. The Kansas Hazard Mitigation Team (KHMT) has chosen to establish a statewide policy for the definition of “critical facilities” that is to be used in local mitigation plans. This definition is “any facility, system or property deemed to be vitally important to the community in the opinion of the local responsible organization or the local mitigation planning group.” This is not a strict definition. The KHMT encourages local planners and state agency representatives to use their own judgment regarding which of the facilities, for which they are responsible, should be considered critical based on the unique needs of their jurisdictions and/or agencies.

In 2004, the state agencies and organizations participating in development and implementation of the Kansas Hazard Mitigation Plan conducted detailed vulnerability assessments of state-owned and operated facilities using a proprietary software system. This method involved judgments regarding the vulnerabilities of state facilities and campuses by the KHMT. Unfortunately, the detailed evaluations that went into this assessment were in the proprietary software system. During the previous update, the state did not renew its contract with the vulnerability software provider and thus did not complete additional vulnerability assessments in this manner. Attempts to obtain the database from the software vendor in 2007 were unsuccessful. Information from the 2004 vulnerability assessment is provided here in summary form.

There were 432 vulnerability assessments conducted by the following state agencies during the 2004 plan development:

- Adjutant General's Department—70 assessments
- Kansas Department of Administration—24 assessments
- Kansas Department of Corrections—12 assessments
- Kansas Department of Transportation—322 assessments
- Kansas State Fire Marshal's Office—1 assessment
- Kansas Highway Patrol—3 assessments

Based on this inventory, approximately 64% of the state-owned facilities were assessed for their vulnerabilities to different hazards and/or the consequences to the community of their damage or disruption. Therefore, the evaluations completed, represent a significant number of the state-owned facilities that are considered by the KHMT to require vulnerability assessments. Another principal concern regarding the state's vulnerability assessment process is identification of the state facilities that must not be disrupted by the impacts of a disaster. The 2004 assessment indicated that the state's correctional facilities and five of the state's other buildings have been given this designation. As the planning process matures, the mitigation needs and capabilities of all public and private agencies and organizations can be evaluated in the Kansas Hazard Mitigation Plan as data becomes available from state and local sources.

One of the conclusions of this vulnerability assessment process is that windstorms and lightning represent the largest threats to state facilities. A large number of assessments conducted by the Kansas Department of Transportation included communications towers and skewed the data. Fire, hazardous materials, and terrorism were considered the most significant hazards for the potential for dollar losses.

A total of 10 state campuses were assessed in 2004 for their vulnerability and the consequences of their being damaged or disrupted. Five of these facilities are designated as confidential by the responsible agency and will not be discussed specifically in this edition of the Kansas Hazard Mitigation Plan. Nevertheless, the identified vulnerabilities can be discussed in compiled form. The state campuses are exposed to the most vulnerability from a hazardous materials accident (2 campuses), a radiological accident (1 campus), a terrorist attack (1 campus), and lightning (1 campus).

The state has made efforts to develop databases and GIS data of facilities. The GIS data layers of critical facilities pertinent to this planning process available during the previous update of this plan are listed in Table 3.89. These layers contain a mix of state and local facility data. Building valuations were not included in these databases.

Table 3.92. Inventory of GIS-Based Critical Facilities Data

Facility	Date	Number of Features in Database	Source
Schools	2007	1648	Kansas Department of Education
National Guard Facilities	2007	132	Kansas National Guard
Health Facilities	2006	872	Kansas Department of Health and Environment
Airports	2006	142	Kansas Department of Transportation, only a partial listing, being updated to include all FAA licensed sites in Kansas
Fire Stations	2006	956	Kansas State Fire Marshal's Office/TechniGraphics
Emergency Medical Services Stations	2006	183	Kansas Board of Emergency Medical Services/TechniGraphics
Assisted Living Facilities and Nursing Homes	2006	593	Kansas Department of Aging
Shelters	2007	63	American Red Cross
State Prisons	2006	23	Kansas Department of Corrections
Colleges and Universities	2006	108	Kansas Board of Regents/Kansas Department of Education
Electric Power Plants	2004	101	Kansas Conservation Commission
Electric Substations	2005	324	PennWell MAPSearch data

The GIS-based facilities layers can be used to determine vulnerability to specific hazards areas as GIS-based hazard data becomes available. GIS can be used to overlay facility locations on hazard layers such as flood (with Digital Flood Insurance Rate Maps), landslide, expansive soils, dam failure, and land subsidence. During the previous plan update, this digital hazard data was not available.

During the previous update, one of the limitations noted was that each agency maintains separate databases of its own facilities with different database items. Many of these databases are not spatially enabled and thus could not be analyzed spatially in GIS. A database of state-owned or leased buildings was available from the Kansas Department of Administration Division of Facilities Management. During the 2010 plan update, KHMT attempted to obtain a new list, however, they were denied because very little changes had been made and other undisclosed reasons. The state will attempt to obtain updated data inclusion in the 2013 plan update. According to this data, the total exposure of state owned buildings is:

Total Number of all Buildings: 2,720
Total Square Footage: 44,474,967
Total Replacement Value: $7,620,555,619

In terms of general exposure of replacement value and square footage, the Kansas Board of Regents' state university properties outnumber the other agencies. The Kansas Departments of Transportation and Corrections also have a significant inventory of structures that could be exposed to hazards. Tornadoes are considered the natural hazard with the ability to destroy or do the most significant damage to state buildings in Kansas as they have the potential to strike anywhere in the state. Those counties with a high or very high relative vulnerability to tornadoes (as determined in the analysis described in the tornado hazard profile) are indicated in Table 3.93. In terms of potential losses, Riley, Douglas, Shawnee, Sedgwick, and Wyandotte Counties have the greatest exposure of state buildings and could suffer considerable losses to the state if

a significant tornado were to hit those counties. State college campuses are also vulnerable because of the concentrations of buildings and student and faculty populations.

Without specific location data for buildings and hazards such as flood, it is not possible to refine the loss estimation beyond this exposure analysis. GIS-based hazard and inventory data would facilitate additional analysis and loss estimation. Actions to address these limitations are listed in Chapter 4 and detailed in Appendix N: “Improve state facility inventory and mapping,” “Develop a database for GIS-based critical facility data,” and “Refine risk/vulnerability assessment in regards to public health and improve coordination on state vulnerability assessments.”

The information presented is based on state facilities only and does not include information on critical facilities from local hazard mitigation plans. This information will be captured in future updates to this plan as more plans with local critical facilities data become available.

Table 3.93. State Building Inventory by County

KANSAS STATE FACILITIES - 2010			
COUNTY	**# OF BUILDINGS**	**GROSS AREA**	**REPLACEMENT COST**
ALLEN	15	71,479	$3,646,645.00
ANDERSON	14	42,538	$2,545,902.00
ATCHISON	32	178,021	$23,215,656.00
BARBER	4	8,219	$517,791.00
BARTON	29	69,922	$3,814,200
BOURBON	9	38,239	$1,473,086
BROWN	20	81,673	$5,568,871
BUTLER	55	693,750	$95,273,554
CHASE	4	6,906	$366,526
CHAUTAUQUA	4	8,635	$451,467
CHEROKEE	7	14,336	$849,410
CHEYENNE	4	8,393	$627,167
CLARK	5	18,589	$403,760
CLAY	10	31,937	$2,566,847
CLOUD	5	33,873	$2,656,442
COFFEY	8	29,144	$2,008,331
COMANCHE	5	11,625	$410,742
COWLEY	44	519,941	$78,471,525
CRAWFORD	65	1,810,520	$269,352,579
DECATUR	4	7,378	$506,155
DICKINSON	6	26,596	$1,994,368
DONIPHAN	9	28,596	$1,912,917
DOUGLAS	139	7,527,973	$1,031,556,138
EDWARDS	4	9,386	$740,033
ELK	1	1,586	No Value Given
ELLIS	67	2,057,728	$239,482,435

ELLSWORTH	28	292,604	$66,933,395
FINNEY	27	120,600	$7,672,616
FORD	117	202,258	$27,655,860
FRANKLIN	10	42,368	$2,858,904
GEARY	13	62,068	$3,055,549
GOVE	4	8,326	$617,858
GRAHAM	4	7,482	$521,281
GRANT	7	14,391	$1,089,106
GRAY	5	7,339	$593,423
GREELEY	11	17,623	$423,541
GREENWOOD	4	8,329	$612,040
HAMILTON	7	20,893	$1,089,106
HARPER	5	13,232	$1,040,236
HARVEY	10	79,419	$1,887,319
HASKELL	2	5,122	$439,831
HODGMAN	4	10,674	$189,662
JACKSON	9	23,449	$721,416
JEFFERSON	6	23,173	$2,242,209
JEWELL	11	37,704	$2,693,677
JOHNSON	40	415,698	$60,540,828
KEARNEY	4	7,339	$3,377,859
KINGMAN	9	32,104	$2,082,799
KIOWA	7	8,582	$529,426
LABETTE	70	431,869	$46,674,500
LANE	3	10,271	$399,106
LEAVENWORTH	133	1,126,933	$121,805,400
LINCOLN	4	7,690	$366,526
LINN	8	11,954	$918,060
LOGAN	11	29,608	$1,453,305
LYON	80	1,660,782	$231,138,436
MARION	9	16,849	$1,042,563
MARSHALL	4	20,645	$1,769,798
MCPHERSON	7	22,499	$1,921,062
MEADE	4	7,046	$423,541
MIAMI	53	547,034	$75,301,945
MITCHELL	33	129,712	$16,637,964
MONTGOMERY	18	66,013	$5,223,289
MORRIS	12	32,275	$1,456,796
MORTON	4	7,724	$470,084
NEMAHA	7	28,907	$2,677,387
NEOSHO	26	152,999	$15,719,903
NESS	4	7,618	$318,819
NORTON	52	376,126	$50,416,558

OSAGE	11	25,964	$1,194,991
OSBORNE	4	7,369	$402,597
OTTAWA	5	8,227	$518,954
PAWNEE	93	896,826	$120,710,475
PHILLIPS	9	41,705	$2,658,769
POTTAWATOMIE	16	70,198	$4,880,035
PRATT	9	35,474	$2,436,526
RAWLINS	7	20,898	$1,139,140
RENO	208	1,645,730	$180,849,870
REPUBLIC	9	34,578	$2,217,774
RICE	5	7,809	$411,905
RILEY	172	7,233,749	$1,224,984,259
ROOKS	14	63,186	$5,906,308
RUSH	4	8,926	$690,004
RUSSELL	11	33,351	$2,174,722
SALINE	45	635,750	$132,973,397
SCOTT	5	13,379	$423,541
SEDGWICK	96	2,933,172	$559,457,526
SEWARD	6	28,786	$2,109,562
SHAWNEE	203	4,969,866	$808,988,249
SHERIDAN	10	16,294	$612,040
SHERMAN	7	47,738	$3,498,871
SMITH	7	30,045	$2,188,685
STAFFORD	3	4,796	$84,941
STEVENS	6	15,422	$508,482
SUMNER	5	13,452	$318,819
THOMAS	20	63,617	$2,286,425
TREGO	8	14,306	$905,261
WABAUNSEE	13	25,291	$925,042
WALLACE	4	7,410	$509,646
WASHINGTON	7	15,721	$736,543
WICHITA	1	1,098	$84,941
WILSON	6	8,095	$456,121
WOODSON	5	9,188	$922,715
WYANDOTTE	79	2,532,739	$504,701,994
TOTALS	**2,568**	**41,012,469**	**$6,109,284,660**

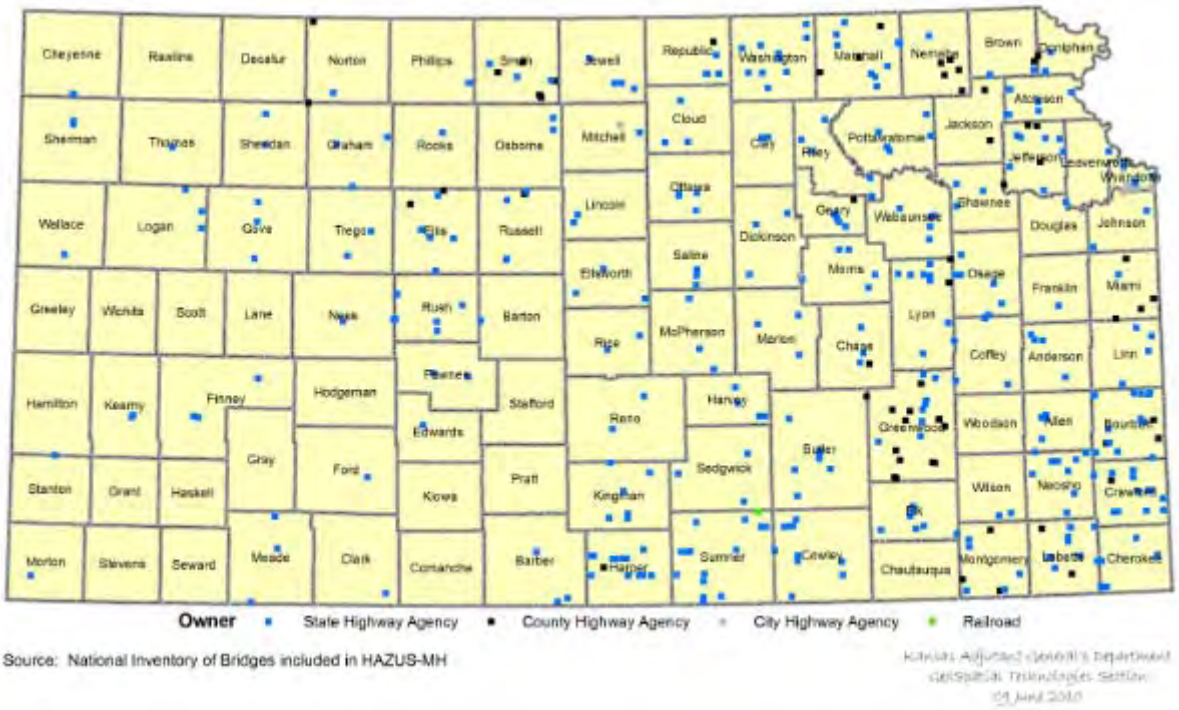
Table 3.94. State Building Inventory Summary by Agency

Agency	Building Count	Total Square Footage	Total Replacement Value
Adjutant General's Department	163	1,670,115	$192,143,244
Juvenile Justice Authority	78	830,414	$139,037,182
Kansas Board of Regents/Emporia State University	68	1,695,030	$290,864,494
Kansas Board of Regents/Ft. Hays State University	44	1,968,881	$349,898,067
Kansas Board of Regents/Kansas State University	222	7,638,470	$1,726,436,496
Kansas Board of Regents/Kansas State University-Salina	18	301,253	$61,207,410
Kansas Board of Regents/University of Kansas	184	8,859,367	$1,541,533,115
Kansas Board of Regents/University of Kansas Medical Center	54	3,089,595	$507,279,865
Kansas Board of Regents Wichita State University	66	2,858,591	$542,330,649
Kansas Bureau of Investigation	4	99,394	$12,883,270
Kansas Commission on Veterans Affairs	123	430,875	$56,690,568
Kansas Department of Administration	26	2,438,676	$492,740,150
Kansas Department of Administration/State Complex West	32	493,728	$60,839,000
Kansas Department of Commerce	11	83,452	$10,848,760
Kansas Department of Corrections	399	3,811,542	$609,940,110
Kansas Department of Labor	10	175,158	$21,494,790
Kansas Department of Social Rehabilitation Services	177	2,173,883	$291,981,292
Kansas Department of Transportation	727	2,168,079	$175,856,706
Kansas Department of Wildlife and Parks	82	186,207	$20,455,237
Kansas Highway Patrol	11	279,474	$38,471,807
Kansas Insurance Department	1	40,000	$5,200,000
Kansas State Fair	72	743,988	$68,097,305
Kansas State Historical Society	48	250,620	$35,253,320
School for the Blind	10	115,076	$14,964,981
School for the Deaf	13	244,582	$38,118,868

Source: Kansas Department of Administration

Vulnerability analysis of state-owned or operated infrastructure is discussed below. Included with HAZUS-MH is a database of bridges called the National Bridge Inventory developed by the Federal Highway Administration. One of the database items includes a "scour index," which is used to quantify the vulnerability of a bridge to scour during a flood. Bridges with a scour index between one and three are considered "scour critical," or a bridge with a foundation element determined to be unstable for the observed or evaluated scour condition. (For a definition of "scour" and "scour critical" please reference Appendix M.) A query of the database was performed that identified scour-critical bridges in Kansas. These are shown in Figure 3.81 by ownership. According to the American Society of Civil Engineers Report Card for America's Infrastructure, 23% of bridges in Kansas are structurally deficient or functionally obsolete. The serious outcome of a bridge collapse was realized by the I-35 collapse in Minneapolis, Minnesota on August 1, 2007, which had also been rated "structurally deficient."

Figure 3.81. Flood Scour Critical Bridges



This map remains the most current at the time of the 2010 plan revision.

The electric power infrastructure in Kansas has been significantly affected by disasters and weather events. GIS was used to visualize the potential vulnerability of electric lines to tornado, windstorm, and winter storm. The electric line inventory was quantified in terms of the meters of line traversing a particular county. This value is represented as a graduated circular symbol in Figures 3.82, 3.83, and 3.84 overlaid on the relative vulnerability maps for each hazard (see hazard profiles for how these hazard vulnerability maps were developed). The maps indicate where there is more potential for impacts to the power infrastructure and could be used to help prioritize mitigation efforts. Potential losses to the electric line infrastructure are difficult to quantify. This information could potentially be obtained or estimated with assistance from rural electric cooperatives in future updates to this plan.

Figure 3.82. Electric Line Inventory and Tornado Vulnerability

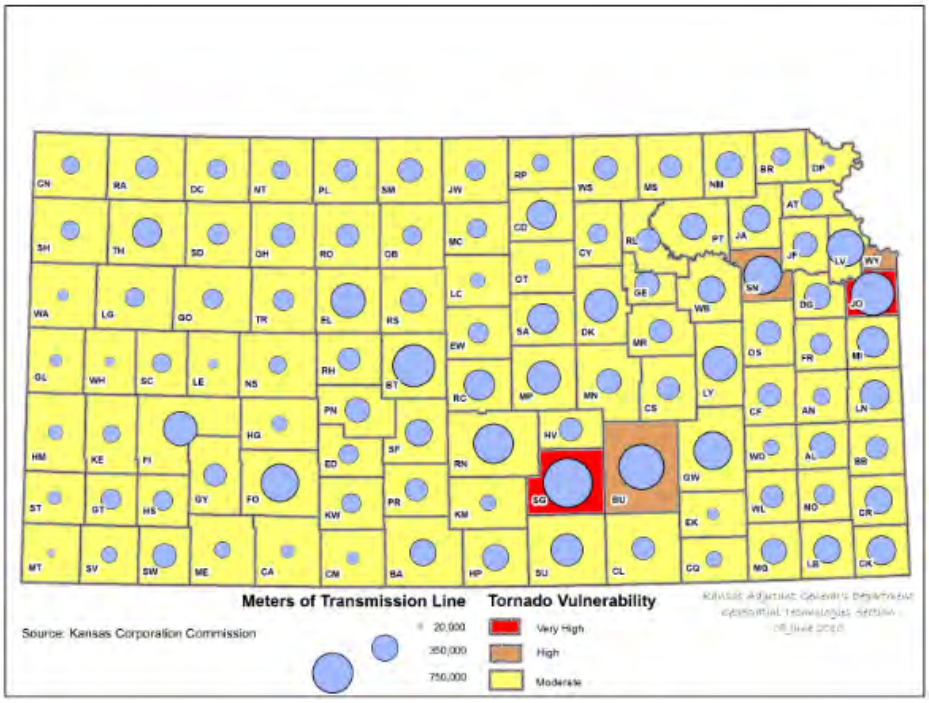


Figure 3.83. Electric Line Inventory and Windstorm Vulnerability

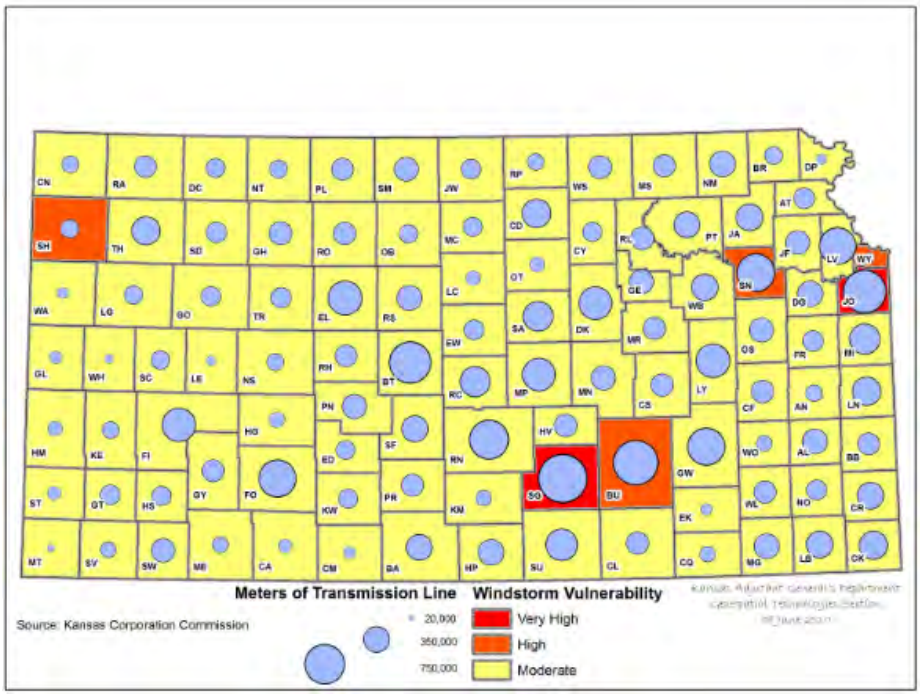
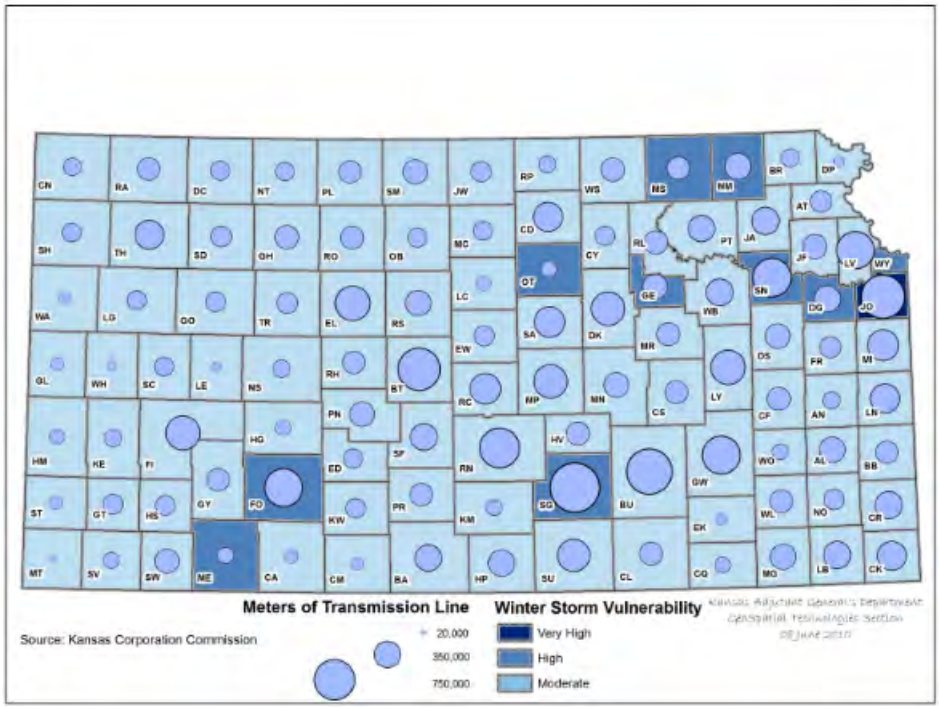


Figure 3.84. Electric Line Inventory and Winter Storm Vulnerability



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4 MITIGATION STRATEGY

This chapter focuses on the state's hazard mitigation strategy. It is divided into five parts:

- Hazard Mitigation Goals and Objectives
- State Capability Assessment
- Local Capability Assessment
- Mitigation Actions
- Funding Sources

4.1 Mitigation Goals and Objectives

IFR REQUIREMENT 201.4(c)(3)(i):	[The mitigation strategy shall include] a description of State goals to guide the selection of activities to mitigate and reduce potential losses.
Explanation:	The State's goals as written in the plan reflect the State's vision for long-term hazard mitigation and loss reduction. This section *should* describe how the plan's goals were developed. These goals, along with their corresponding objectives, guide the development and implementation of mitigation actions. Although the Rule does not require a description of objectives, States are highly encouraged to include a description of the objectives developed to achieve the goals so that reviewers understand the connection between goals, objectives, and actions. The goals and objectives should: ▪ Be based on the findings of the local and State risk assessments. ▪ Represent a long-term vision for hazard reduction or enhancement of mitigation capabilities.
IFR REQUIREMENT Update §201.4(d):	[The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities.

This section describes the mission, goals, and objectives of the Kansas Hazard Mitigation Plan and the process used to update the goals and objectives in 2010. The state has updated the framework of its mitigation strategy to improve its ability to track progress in meeting plan goals and to improve alignment with local mitigation strategies (goals, objectives, and actions). The framework of the state's mitigation strategy has four parts: mission, goals, objectives, and actions, which are defined as follows:

- The **mission** is a philosophical or value statement that states the purpose and primary function of the strategy.
- The **goals** describe the overall direction that the state will take to reach their mission.
- The **objectives** link the goals and actions and help organize the plan for efficient implementation and evaluation.
- The **actions** describe the activities or projects used to support the accomplishment of the goals and mission.

4.1.1 2010 Updated Goals and Objectives

During the 2010 update process, the Kansas Hazard Mitigation Team (KHMT) reviewed the mission statement and updated the goals and objectives from the previously approved plan to guide the development and implementation of the hazard mitigation plan. The updated mission, goals, and objectives follow:

Mission: To create a disaster-resilient Kansas through the implementation of a statewide comprehensive mitigation strategy

Goal 1: Minimize the vulnerability of the people, property, environment, and economy of Kansas and its communities to the impacts of natural and manmade hazards

- 1.1 Encourage life and property protection measures for all communities and structures
- 1.2 Protect critical facilities, infrastructure, and utility systems
- 1.3 Reduce repetitive property losses due to flood, wildfire, and other hazards
- 1.4 Reduce potential damage to future buildings and infrastructure
- 1.5 Encourage the incorporation of mitigation measures into repairs, redevelopment, and capital improvement projects
- 1.6 Preserve and restore natural systems to serve natural mitigation functions

Goal 2: Build the mitigation capabilities of local governments throughout Kansas in establishing and implementing effective mitigation plans, policies, and programs

- 2.1 Encourage all Kansas communities to develop, implement, and adopt a local hazard mitigation plan, and update FEMA-approved mitigation plans every five years.
- 2.2 Increase community participation in the National Flood Insurance Program
- 2.3 Encourage local governments to adopt and enforce building codes, mitigation-related ordinances, and land use planning
- 2.4 Develop technical support programs and guidance materials to facilitate local planning and projects
- 2.5 Identify and provide financial incentives and funding opportunities
- 2.6 Encourage communities to participate in the Community Rating System (CRS)

Goal 3: Promote a state policy framework for effective hazard mitigation programming in the state

- 3.1 Promote coordination among federal, state, and local organizations, plans, and programs related to hazard mitigation
- 3.2 Institutionalize the Kansas Hazard Mitigation Team as the entity responsible for the monitoring, review, and updating of the Kansas Hazard Mitigation Plan
- 3.3 Incorporate mitigation concepts into existing and future policies and regulations of the state
- 3.4 Implement, monitor, and assess the effectiveness of the mitigation plan and promote successes
- 3.5 Enhance capabilities to collect, analyze, update, and exchange data and information to support risk assessment and mitigation needs
- 3.6 Incorporate a standardized probability methodology for local plans to allow consistency and ease the roll up of information into the state plan

Goal 4: Improve education and training in hazard mitigation and related programs for government officials, businesses, and the public

- 4.1 Identify and develop needed training and education to targeted audiences
- 4.2 Strengthen outreach and partnerships with the private sector, nonprofit organizations, and the public
- 4.3 Improve public understanding of hazards and risk by providing awareness, preparedness, and mitigation information through various channels of communication

4.1.2 Process for Updating Goals and Objectives

The planning team for the 2002 Kansas Mitigation Strategy established goals and objectives for the strategy in a workshop-type discussion. These goals and objectives were reviewed and modified slightly from the previous Kansas Hazard Mitigation Plans. During the 2010 plan update, the KHMT reviewed the existing goals and objectives and determined them to be applicable for the long term and for providing the ability for growth. The KHMT made only minor revisions to the previous goals and objectives.

The intention of the KHMT was to establish mitigation goals that had applicability over the long term. These goals would continue to provide direction to state and local mitigation efforts for many years through future updates and revisions. The team believed that this approach was more feasible with capability-based goals, rather than hazard-specific goals. It would ensure the statewide applicability of each goal, rather than focus on a specific hazard type that may not be applicable in all regions or communities. The KHMT intended the objectives to be more specific, providing direction and detailed guidance for each goal and to be more short term in nature and be evaluated and revised during plan updates. The KHMT also recognized the importance of ensuring that the objectives address vulnerabilities to the high priority hazards identified through the statewide risk assessment.

Each team member was given a list of the goals and objectives to see if these still met the current state needs to reduce the threat of hazards. Each team member was able to rank every goal and objective according to how he/she believed it met the goal. These were then calculated and prioritized accordingly.

As part of the 2010 plan update, the goals and objectives from the previous plan were assessed to determine if they still addressed current and anticipated future conditions. The assessment was based on the following:

- The updated statewide risk assessment, which includes changes in growth and development, recent disasters, and enhanced vulnerability assessments
- Assessment of changes and challenges in state and local capabilities since the previous plan
- Mitigation tasks from the preceding plan
- Analysis of the similarities and differences of the state mitigation plan goals with local mitigation plan goals and objectives
- Analysis of mitigation actions completed since 2007 that were not specifically aligned with the goals of the 2007 plan

Because of this assessment, a mission statement and updated goals and objectives were drafted and presented to the KHMT for review and then revised to reflect their input.

The key issues identified in the statewide risk assessment can be found in Chapter 3 Risk Assessment. Information on the changes in state and local mitigation capabilities is summarized in Section 4.2 State Capability Assessment and Section 4.3 Local Capability Assessment. Section 4.4 Mitigation Actions includes detailed and updated mitigation actions designed to meet the designated goals and objectives. The following section describes how local mitigation plan goals and objectives were reviewed and considered during the 2010 update.

Review of Local Goals and Objectives

The KHMT analyzed the goals and objectives of 40 FEMA-approved local hazard mitigation plans covering 40 counties to assess their consistency with state goals and objectives. The analysis involved calculating the percentage of local plans (out of a total of 40 plans with identified goals and objectives) that had goals similar to the goals of the previous State of Kansas Hazard Mitigation Plan. The results of the analysis are presented in Table 4.1.

Table 4.1 Local Plans with Goals Similar to State Plan Goals

2007 State Plan Goals	Percent Local Plans with Similar Goal
Local government mitigation capabilities	55%
Vulnerability of people, property, and economic vitality	63%
Training and educational opportunities in hazard mitigation for public officials, businesses, and the public	55%
Policy and regulatory framework for effective hazard mitigation programs	50%
Mechanisms for data collection and exchange	0% goal; 28% objective

Source: FEMA News Photo Meade, KS

In updating state goals and objectives, the KHMT reorganized the previous goals to be more reflective of the priorities shown by the local governments. The KHMT also analyzed other goals that occur commonly in local plans but waver from the state goals and objectives. Table 4.2 lists common goals in local plans and the percent of plans that contain the similar goal.

Table 4.2 Other Goals Common in Local Plans

Other Goals Common in Local Plans	Percent Local Plans with Similar Goal
Emergency response and operations	70%
Infrastructure/critical facilities	58%
Continuity of local governance	25%
Cooperation among all sectors	27%
Flood	63%
Tornado	58%
Terrorism	25%

The most common goals that occur in local plans are related to emergency response and operations. Projects related to these goals are unlikely to be funded through Federal Emergency Management Agency (FEMA) mitigation grant programs; however, FEMA funding is not a requirement to include a mitigation action item in a local plan. In the beginning, many communities started preparing plans using the MitigationPlan.com or Mitigation 20/20 software programs. However, there were some formatting problems and a lot of confusion using this software with the local jurisdiction, KDEM, and FEMA. Eventually the communities and the state discontinued use of these programs and used individual contractors instead. One of the concerns now is the inconsistency in methodology being used by different contractors for hazards. It is hopeful that the contractors will be using the same methodology during their next plan update with KDEM setting guidelines for a standard methodology.

4.2 State Capability Assessment

IFR REQUIREMENT 201.4(c)(3)(ii):	[The State mitigation strategy shall include] a discussion of the State's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: - an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas: [and] - a discussion of State funding capabilities for hazard mitigation projects.
Explanation:	The State **shall** include a discussion of its financial, legal, and programmatic ability to carry out mitigation actions in the pre-and post-disaster setting to achieve its mitigation objectives and, ultimately, its goals. The mitigation strategy *should* not only address the ways the State's existing capabilities can aid the mitigation effort, but also address areas in which the State needs to strengthen its capabilities. Without an assessment of the State's capability, implementation of the plan could stall from inadequate resources. The State **shall** conduct an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas. The State *should* discuss existing and emerging State policies and programs for both pre- and post-disaster mitigation. The discussions *should* include: implementation opportunities and problems (e.g., financial/staffing resources, lack of informed public, non-mandated improvements, etc.), opportunities for improving State capabilities, conflicts created by public investment policies (e.g., policies that have promoted public investment in hazard-prone areas), and problems created by private development projects in hazard-prone areas. The State *should* highlight implementation tools, policies, and programs that have proven to be effective in achieving mitigation objectives (e.g., planning legislation requiring integration of mitigation actions in comprehensive plans). The State *should* also identify those laws, regulations, and policies that can be amended to integrate mitigation actions or to remove provisions that hinder mitigation efforts. The State **shall** describe its assessment of its funding capabilities for hazard mitigation projects. The discussion *should* include positive aspects, as well as problems encountered, and identify areas where the State needs to seek outside funding sources.

The state capability assessment evaluates existing capabilities of state agencies and organizations for implementing mitigation-related programs. This assessment allows for improving mitigation capabilities at the state and local levels. The state capability assessment is meant to do the following:

- Identify agencies or statewide organizations that have applicable mitigation capabilities or programs that should be direct participants in the statewide mitigate on planning process
- Incorporate all suitable state agency programs and capabilities into the state's hazard mitigation planning and programming to identify programs with complementary purposes or funding sources to permit their coordinated use to resolve specific mitigation-related problems
- Identify state statutes, agency regulations, and agency policies that are related to hazard mitigation and development in hazard-prone areas
- Assess state funding capabilities for hazard mitigation projects
- Assess strengths and opportunities in the state's mitigation capabilities and identify weaknesses and obstacles to improve state capabilities and define possible corrective actions

As part of the update process, this section will also highlight the changes in state mitigation capabilities since the development of the previous plan update.

4.2.1 State Agencies and Mitigation-Related Programs

Many Kansas state agencies have programs that are directly or indirectly related to hazard mitigation. A goal of the state‘s mitigation strategy is to continue to improve the integration and use of these programs to enhance statewide mitigation capabilities. This section highlights agencies involved in mitigation and summarizes their mitigation-related programs. The majority of these programs can be considered pre-disaster as many of the mitigation programs listed here are implemented as part of the day-to-day functions of state agencies. Many of these programs also support mitigation opportunities that arise in the post-disaster environment. Tables 4.3 and 4.4 at the end of this section summarize the technical, program implementation, and local support capabilities of these state agencies.

Adjutant General’s Department

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The Adjutant General‘s Department consists of the Division of Emergency Management (see below), the Kansas Air National Guard, and the Kansas Army National Guard.

Mitigation-Related Programs and Planning

Enterprise Geospatial Technology (GIS)-The Geospatial Technology Section coordinates and manages the geographic information system (GIS) for the Adjutant General‘s Department. The section provides GIS support to all divisions within the department, including, but not limited to, the Kansas Division of Emergency Management, Kansas Army National Guard Joint Operations Center, Communications Assessment Team, Vulnerability Assessment Team, Technological Hazards Section, the 73rd Civil Support Team, and the Division of Facilities and Engineering. The section is responsible for data creation, requests, and distribution to and from other state agencies, federal entities, and local governments. The section provides easy to use Internet maps and desktop applications to non-GIS users across the department.

Adjutant General’s Department—Kansas Division of Emergency Management

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The Kansas Division of Emergency Management (KDEM) is designated to provide staff support to the Kansas KHMT and is responsible for maintenance of this mitigation plan. The mission of the division is to provide a 24-hour operation to reduce loss of life and property and to protect Kansas from all hazards. This support is provided by coordinating resources, expertise, leadership, and advocacy through a comprehensive, risk-based emergency management program of mitigation, preparedness, response, and recovery. The division provides mitigation advocacy, planning requirements and guidance, response coordination, and administration of recovery programs for the civil sector of the state. These services are provided regardless of the

type of hazard. KDEM has six sections: Administration, Plans/Mitigation, Training, Response and Recovery, Fiscal, and Preparedness.

Mitigation-Related Programs and Planning

Comprehensive Emergency Planning Support for Local Government- Kansas statutes require all 105 counties to have emergency management offices with designated points of contact for county emergency management coordinators and local emergency planning committees. KDEM provides guidance to local governments on regulations regarding the contents and format of county emergency management plans and reviews and approves these plans. The regulations contain provisions for mitigation elements within the emergency plans.

Disaster Response and Recovery Operations- KDEM coordinates state resources and services for local governments and the public impacted by disasters. Upon receipt of a presidential major disaster declaration, the division also coordinates provisions of federal disaster relief.

Emergency Water Supply- KDEM coordinates obtaining water or water supply equipment when a local water system is inoperative or in the event of a drought, if requested.

Mitigation Planning Support for Local Governments- KDEM provides guidance and support for local hazard mitigation plan development and maintenance, including technical support, training, funding, and review.

Kansas Planning Standards- The Kansas Planning Standards is intended to be an all-encompassing guide to review or redevelop local emergency operations plans. It includes the planning requirements from the Nuclear Regulatory Commission and the most recent suggested considerations from FEMA and the U.S. Department of Homeland Security.

Kansas Response Plan- The Kansas Response Plan is designed to address natural and manmade hazards that could adversely affect the State of Kansas. The plan applies to all state government departments and agencies that are tasked to provide assistance in a disaster or emergency situation. It describes the fundamental policies, strategies, and general concept of operations to be used to manage an emergency, through all phases of emergency management.

Incident-specific annexes are plans that address the full spectrum of activities related to specific incident types, which include prevention, preparedness, response, and recovery actions. The coordinating agency is responsible for developing and exercising these plans. KDEM is charged with approving the plans and adding them as annexes to the Kansas Response Plan.

The Hazard Mitigation Grant Program (HGMP) - The Hazard Mitigation Grant Program is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, United States Code (U.S.C.) 5170c. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under the Presidential Major Disaster Declaration, in the areas of the state requested by the governor. The amount of HMGP

funding available to the applicant is based upon the total federal assistance to be provided by FEMA for disaster recovery under the major disaster declaration.

The Pre-Disaster Mitigation (PDM) program- The Pre-Disaster Mitigation program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist states, territories, Indian tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding from future major disaster declarations.

The Flood Mitigation Assistance (FMA) program-The Flood Mitigation Assistance program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended (NFIA), 42 U.S.C. 4104c, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).

The Repetitive Flood Claims (RFC) program-The Repetitive Flood Claims program is authorized by Section 1323 of the NFIA, 42 U.S.C. 4030, with the goal of reducing flood damages to individual properties for which one or more claim payments for losses have been made under flood insurance coverage and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period of time.

The Severe Repetitive Loss (SRL) program-The Severe Repetitive Loss program is authorized by Section 1361A of the NFIA, 42 U.S.C. 4102A, with the goal of reducing flood damages to residential properties that have experienced severe repetitive losses under flood insurance coverage and that will result in the greatest amount of savings to the NFIF in the shortest period of time.

Fire Management Assistance Grant Program

This program, which provides a 75% federal share/25% state share, is available to states, as well as local and tribal governments. It provides for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster. The process is initiated when the state requests federal assistance for an event where the threat of major disaster exists for either single fires or numerous small fires.

Continuity of Operations (COOP) and Continuity of Government (COG) Initiatives

COOP planning is an effort to assure that the capability exists to continue essential agency functions across a wide range of potential emergencies. The objectives of a COOP plan include:

a. Ensuring the continuous performance of an agency's essential functions/operations during an emergency

b. Protecting essential facilities, equipment, records, and other assets

c. Reducing or mitigating disruptions to operations

d. Reducing loss of life, minimizing damage and losses

e. Achieving a timely and orderly recovery from an emergency and resumption of full service to customers

COG planning is essentially an integration of all agencies capabilities within the COOP to assure the best possible surviving governmental structure should a major disaster event have the potential to disrupt normal operations.

Commission on Emergency Planning and Response

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The Commission on Emergency Planning and Response is established by the Kansas Emergency Management Act and implements provisions of the Federal Emergency Planning and Community Right-to-Know Act in Kansas. The commission serves as the technical advisor and information clearinghouse for state and federal hazardous materials programs. The primary focus of the commission is to enhance state and local emergency response and preparedness capabilities through improved coordination and planning. The commission is comprised of representatives from various state and local government organizations and industry as appointed by the governor. Membership was expanded and now includes agency heads from the Adjutant General‘s Department, Kansas State Fire Marshal‘s Office, Kansas Department of Transportation, Kansas Department of Health and Environment, Kansas Highway Patrol, Kansas Department of Commerce, Kansas Bureau of Investigation, Kansas Department of Agriculture, the Kansas Animal Health Department, and 18 members from various state and local agencies.

Data Access and Support Center

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The Data Access and Support Center (DASC) were created by the Kansas Geographic Information Systems (GIS) Policy Board. This board was established by the governor in 1989 to develop Kansas GIS technology management policies and direct the Kansas GIS Initiative. The GIS Policy Board consists of directors of the major state, federal, and local agencies that are using GIS technology. The GIS Policy Board realized that a central delivery and distribution center for core GIS databases was essential to ensure the effective and efficient development and implementation of GIS technology in state government. DASC was established in 1991 to administer the access to the core database.

The GIS Policy Board has a budgeted fund allocated in the Kansas Water Plan to help acquire the necessary layers of information. Currently, data is being acquired and developed for Kansas from various federal, state, and educational institutions. One of the basic services of the center is to receive, archive, and catalog all core databases and to maintain associated documentation and information. Local governments in Kansas can back up their GIS data with DASC for free.

The Kansas Geospatial Community Commons is an online initiative of the Kansas GIS Policy Board and DASC designed to be a place for state and local governments and the private sector

to share geospatial information and connect with the Kansas GIS community. The website also includes portals for collecting information on specific topics, such as the Greensburg tornado disaster or the flood disaster in southeast Kansas.

Kansas Animal Health Department

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The Kansas Animal Health Department is divided into four divisions: administration, disease control, animal facilities inspection, and brands. One of the agency's goals is to eradicate infectious and contagious livestock diseases throughout the state. The responsibilities of the department are related to the identified hazards of agri-terrorism and agricultural infestation. The department has developed a Foreign Animal Disease Emergency Response Plan, which is constantly being updated through cooperative emergency planning with all Kansas counties as well as other Kansas agencies and private entities that would be involved in the response. It also serves as an annex to the Kansas Response Plan.

The department trains the Kansas Volunteer Veterinary Response Corps, provides training and exercises to field staff for animal disease emergency issues, conducts ongoing disease surveillance, and has identified pre-approved burial sites for disease-affected livestock. The department is cooperating with the U.S. Department of Agriculture to provide an animal identification system in Kansas.

Kansas Collaborative

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The Kansas Collaborative is an initiative dedicated to optimizing public resources by bringing the state, counties, and cities together as equal partners to cut through bureaucracy and move good ideas into action. Through the initiative, a cross-government GIS Breakthrough Team has been established to link GIS implementation efforts at the state and local levels with the long-term goal of developing critical data layers statewide, which are backed up in multiple locations. The Kansas Collaborative was formed by the merging of two programs, the Budget Efficiency Savings Team Program and the Kansas Association of Counties Outreach Program, which were used to help strengthen ties among the state, county, and local governments. The collaborative was founded by and is managed by TeamTech, Inc., a Kansas-based consulting firm.

Kansas Corporation Commission

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The Kansas Corporation Commission's mission is to protect the public interest by regulating electric, gas, and telecommunications services and ensuring the availability and safety of these utilities. The commission is critical to the development and implementation of this plan, because of the commission's roles in ensuring the adequacy of energy and telecommunication services and managing the risk of damage to underground utilities.

Mitigation-Related Programs and Planning

Kansas Energy Plan- The Kansas Energy Council is charged with the development of a comprehensive state energy plan that includes information about the state's energy resources and recommendations on long-term energy policy to the governor, legislature, and Kansas Corporation Commission. The Kansas Energy Council was dissolved in December of 2008 and a replacement council has not been established.

Kansas Department of Administration—Division of Facilities Management

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The Division of Facilities Management provides services in building maintenance, design and construction, parking, and leasing and space management at the capital complex. Mitigation-related responsibilities include infrastructure construction and maintenance, property acquisition, and property repair and rehabilitation for buildings at the capital complex and the governor's residence.

Kansas Department of Administration—Kansas Information Technology Office

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The Kansas Information Technology Office supports the statutory responsibilities of the executive, judicial, and legislative branch chief information technology officers and the chief information technology architect. The office also supports the Kansas GIS Policy Board. Several components of the Kansas Hazard Mitigation Plan rely on interagency cooperation in gathering, processing, and sharing data and information, in GIS and other formats. The mitigation-related responsibilities of the office include information gathering and management and database development and management, including cyber-security and impacts to communications.

Kansas Department of Agriculture

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The Kansas Department of Agriculture is charged by law to ensure a safe food supply, responsible and judicious use of pesticides and nutrients, the protection of natural and cultivated plants, integrity of weighing and measuring devices in commerce, and beneficial use of the state's waters. Mitigation-related responsibilities include environmental protection, natural resource development and use, public health and safety services, community and economic development, and local government grants and loans.

Mitigation-Related Programs and Planning

Agricultural Commodities Assurance Program- This program works to assure that agricultural inputs are safe and not misrepresented.

Fertilizer Program- This program conducts inspection, registration, and sampling of fertilizer products sold, offered, or exposed for sale or distributed in Kansas. It also monitors safe handling and storage of bulk fertilizers, approves containment facility design, and inspects facilities for compliance.

Pesticide Management- The department monitors, manages, and enforces the licensing and certification of businesses and individuals that apply pesticides. This also includes product label compliance, storage, disposal, and environmental protection and standards of application.

Kansas Department of Agriculture—Division of Water Resources

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The Division of Water Resources (DWR) has two programs: Water Structures and Water Appropriation. These programs have authorities and responsibilities important to the mitigation of three Kansas hazards: flood, dam and levee failure, and drought. Mitigation-related responsibilities include: infrastructure construction and maintenance, community and economic development, environmental protection, public health and safety services, regulation and control of land development, local government grants and loans, and natural resource development and its use.

The Water Structures program regulates manmade activities affecting the flow and overflow of any stream. The program enforces limits imposed by laws and courts that such activities are properly planned, constructed, operated, and maintained for their authorized purpose without adversely affecting the environment, public health and welfare, or public and private property. The Water Structures program is responsible for permitting dams that have a height of 25 feet or more, or have a height of six feet or greater, and also have the capacity to impound 50 or more acre feet of water.

Kansas ranks high in the nation for its number of dams with 6096 state-regulated dams as of May 2010. Of these, 209 were designated as high hazard dams because of the level of development in the downstream inundation areas, and 213 are designated as significant hazard dams. High and significant hazard dams are required to have plans prepared and maintained for emergency response to protect public safety in the event of a dam break. At this time 158 high hazard dams and 28 significant hazard dams have plans on file with the Division of Water Resources, Kansas Department of Agriculture.

The Water Structures program provides permit approval for levee and floodplain issues. The Levee Law of 1929 makes it unlawful to construct fills and levees without prior approval of the chief engineer. Currently, the flood control capabilities of some levees are being reassessed to ensure that they continue to offer adequate protection. It is possible that some levees will be found not to be high enough to protect to the base flood elevation. Areas behind some of these levees could be reclassified as vulnerable to flooding. Many of these areas have experienced substantial development since the levees were constructed.

The Water Structures program also serves as the state‘s manager for implementation of the National Flood Insurance Program (NFIP), and the associated Community Rating System (CRS). In this capacity, the division provides training for local floodplain managers and actively supports the Kansas Association for Floodplain Management. This group trains participating and nonparticipating community officials and other interest groups to help them achieve a better understanding of flood hazards and techniques for safer development within floodplains. The DWR publishes quarterly, a free statewide newsletter to promote the objectives and benefits of floodplain management.

The Water Appropriation program exercises state authority to permit the use of both surface water and groundwater, document the annual use of water, enforce water-related statutes, and work toward management of water as a sustainable resource. Allocations for the largest use of water (irrigation) are based on crop needs eight out of ten years. In cases when water use demand exceeds supply, the chief engineer can restrict use of water by junior permit holders. In case of severe water shortages, procedures have been established to develop and implement water management strategies.

Both the Water Structures and Water Appropriation programs have authority to conduct inspections of construction and to enforce statutes related to the individual programs; however, limitations in staffing have resulted in difficulties in accomplishing the mandated work.

Mitigation-Related Programs and Planning

Community Assistance Program- The DWR participates in FEMA‘s Community Assistance Program, which enhances the state‘s capability to provide floodplain management information and technical assistance to help local officials in NFIP and CRS participating communities. It also encourages nonparticipating communities to join the NFIP and CRS.

Floodplain Management Program- The DWR coordinates and provides technical assistance for local, state, and federal floodplain management, including managing the NFIP and floodplain ordinances and regulations adopted by city and county governments.

Interstate Water Matters- The division is responsible for state participation in four interstate compacts pertaining to the apportionment of waters in rivers that flow through Kansas and two or more states and for participation in the Kansas River Basin Association.

Levees and Drainage District Program- This program regulates the construction of levees and dikes and the formation of drainage districts to address local issues regarding drainage problems and their amelioration.

Operations and Technical Services Program- This program provides administrative and technical support to the chief engineer of the DWR. The program addresses interstate compact administration, GIS, intensive groundwater use control areas, flow meter specifications, and water assurance districts.

Special Management Programs- DWR is responsible for management of water resource-related issues, such as the Groundwater Management District Act and the Intensive Groundwater Use Control Area. It also monitors the observation well network, has designated responsibilities under the Water Assurance District Act, and reviews and approves of water conservation plans.

Stream Obstructions Program- This program regulates and monitors the changes in the course, current, or cross section of a stream; processes applications; reviews and approves plans; inspects ongoing projects before, during, and after construction; and performs ongoing safety inspections.

Sub basin Water Resource Management- The DWR is responsible for the development and implementation of proactive subbasin specific, long-term water resource management and the development of programs under the current water rights administrative system. With input from the regulated community and the general public, the Ogallala component of the program helps to define hydrologic subunits.

Water Appropriation Program- This program administers the division‘s responsibilities regarding the management of water resources. These responsibilities include processing of applications for the appropriation of waters of the state, processing applications for changes to water rights, creation of a water transfer panel, facilitation of the hearing and decision review regarding the appropriate transfer of water, issuing certificates of appropriation, inventory, monitoring of water use reports, and administration and enforcement of water rights.

Water Structures Program- This program inspects and regulates dams that could endanger lives and property if they failed. It monitors activities that affect the flow of rivers and streams to ensure these activities are properly planned, constructed, operated, and maintained.

Water Use Report Program- Data collection, review, analysis, and reports for water use information are conducted under this program, a continuation of a cooperative agreement with the U.S. Geological Survey.

Watershed District Program and Multipurpose Small Lakes Program- These programs support the division‘s responsibilities to perform regulatory and supervisory tasks during the formation of a watershed district and for projects to be built under the Small Lakes Program (see State Conservation Commission).

Kansas Department of Commerce

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The Kansas Department of Commerce has responsibility for several key federal and state programs related to hazard mitigation. The department has responsibility for state implementation of the unmet needs program of the U.S. Department of Housing and Urban Development (HUD) and the Community Development Block Grant (CDBG) program. The mitigation-related responsibilities of this department include property repair and rehabilitation, environmental protection, local grants and loans, community economic development, and property acquisition.

HUD grants are one way the department is able to support mitigation programming for designated repetitive flood loss properties. These properties are structures insured under the NFIP that have experienced two flood loss claims in the last 10 years. This makes them a high priority for flood mitigation. Much of the unmet needs funding from HUD has been used by the department to fund removal of vulnerable properties from the floodplain.

Mitigation-Related Programs and Planning

Community Capacity Building Program- This program encourages collaborative community development planning and plan implementation activities and establishes new, ongoing programs to help communities guide development.

Community Service Tax Credit- This incentive program offers Kansas tax credits for contributions to approved projects. Tax credits for nonprofit organizations allow them to improve their ability to undertake major capital fundraising drives. Projects eligible for tax credit awards include community service, crime prevention, and health care.

Kansas Partnership Fund- This fund provides low-interest state loans to cities and counties for infrastructure improvements that support Kansas basic enterprises. Loans are designed to help city and county governments attract new businesses and expand existing businesses.

Small Cities Community Development Block Grant Program- The department administers the CDBG program, awarding grants in five categories: community improvement, urgent need, comprehensive development, Kansas Small Towns Environment Program, and economic development. The CDBG program is a competitive grant process through which about half of the funding goes to support the development of community facilities and water and sewer projects.

Main Street Program-The department operates the Main Street program, a technical assistance program which is funded through the state lottery that targets preservation and revitalization of historic downtown districts. The program‘s ‑incentives without walls” element provides grants for a variety of downtown business needs, including structural needs.

Kansas Department of Corrections—Capital Improvements and Facilities Maintenance

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Mitigation-related responsibilities of the Kansas Department of Corrections include public health and safety services, property repair and rehabilitation, and property acquisition.

Kansas Department of Health and Environment—Bureau of Environmental Remediation

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The Kansas Department of Health and Environment protects the health of Kansans through efficient and effective public health programs and services, and through preservation, protection, and remediation. The department has three divisions: Laboratories, Environment, and Health. The mission of the Bureau of Environmental Remediation is to respond to environmental emergencies and to manage environmental contamination through pollution source control, containment, or remedial action. The bureau‘s responsibilities include the investigation of pollution occurrences and sources from spills, illegal dumping, abandoned facilities, and landfills; storage tank regulation; surface mining site regulation; and designing and overseeing remedial activities at contaminated sites.

Mitigation-Related Programs and Planning

State Water Plan Contamination Remediation Program- Funding from the State Water Plan Fund is provided for the evaluation, monitoring, and remediation of contaminated groundwater or surface water sites, as well as contamination source areas in Kansas where the responsible party is not known or is unable or unwilling to undertake the necessary action. The program also provides funding to supply alternate water sources as an emergency response action to residences with contaminated drinking water sources.

Abandoned Mine Land Program- The Surface Mining Section is responsible for the reclamation of abandoned coalmines in Kansas and administers federal funds from the Office of Surface Mining Reclamation and Enforcement to address past mining problems that are hazardous to the health, safety, and general welfare of the public. Reclamation includes land clearing, backfilling and grading, erosion and site drainage control, guardrail and fence installation, demolition and disposal, and revegetation. The Abandoned Land Mine Emergency Program provides for the remediation of sites that are an immediate threat to the health and safety of the general public. These problems require prompt action and therefore cannot be reclaimed through ordinary program procedures. Emergencies are usually the result of mine subsidence in and around Pittsburg, Weir, and Scammon. Typical abatement activities include backfilling mine subsidence holes in residential areas and near roads and filling subsurface voids beneath structures and roads with cement grout.

Kansas Department of Health and Environment—Center for Public Health Preparedness

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The Bureau of Public Health Preparedness provides leadership to protect the health of Kansans through efforts to mitigate, prepare for, respond to and recover from disasters, infectious disease, terrorism and mass casualty emergencies. The bureau evolved from the Bioterrorism Program, which was a part of the Bureau of Epidemiology and Disease Prevention from 2002-2005 and the Hospital Bioterrorism Program, formerly part of the Office of Local and Rural Health. The bureau works with local, regional and state level health and medical sector agencies and associations to promote the preparedness of all sector partners for all-hazards emergencies. The bureau also focuses on biological incident preparedness and response activities including bioterrorism incidents.

Kansas Department of Labor

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The Kansas Department of Labor administers programs in industrial safety and health, boiler safety and accident prevention. Within these programs, the agency's staff inspects facilities, investigates industrial accidents, and provides training and information to facility owners. Mitigation-related responsibilities may include providing safety and health services to businesses, industry, and the general public in an affected community.

The Kansas Department of Labor also administers the Disaster Unemployment Assistance program. This program provides assistance to individuals who have lost their jobs or income due to a disaster.

Kansas Department of Transportation

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The Kansas Department of Transportation (KDOT) is responsible for providing a statewide transportation system, including the Kansas State Highway System. The State Highway Program has four principal areas of activity: maintaining roadways (Substantial Maintenance Program), service and safety improvements (Major Modification Projects), replacing or rehabilitating bridges (Priority Bridge Program), and highway system expansions or enhancements (System Enhancement).

KDOT also implements a Local Transportation Program that provides state and federal funding to local governments for roadway development, maintenance, and improvement. Additionally, KDOT is responsible for the Kansas Airport Improvement Program, the Rail Service Improvement Fund, and a funding program for public transit.

There are many aspects of KDOT's program activities that are relevant to hazard mitigation programming and the implementation of this plan. As the principal agency responsible for the transportation infrastructure in the state, KDOT's efforts to make the highway network less vulnerable to the impacts of disasters are critical to maintaining the vitality of regional and local economies and to assuring continued transportation capability during and after disasters. Substantial amounts of public funds have been invested in this network and these programs because the mitigation of disaster-caused damage can result in significant savings in the future. In addition, KDOT's safety improvement programs are designed to prevent or reduce human injury and property loss.

Mitigation-Related Programs and Planning

Corridor Management Program- The purpose of this program is to balance traffic and access management with land use management to protect public safety, public investment in the highway system, and private investment in property development on adjacent lands. The goal of corridor management is to create and preserve safe, efficient, and economically viable transportation corridors.

Kansas Forest Service

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The primary mission of the Kansas Forest Service related to the Kansas Hazard Mitigation Plan is its role in wildfire management and its programs in public education and rural fire prevention. Timber is an important contributor to the state's economy, and the agency provides services to ensure the vitality of this economic sector. The Kansas Forest Service maintains a list of timber buyers and sawmills for use when needed, including after a disaster when there is a need to quickly find markets for damaged timber. The agency, upon request, can help prepare management plans for landowners and prepare harvest and planting plans; however, the small size of its staff limits this activity.

The Fire Management program of the Kansas Forest Service trains rural volunteer fire department personnel in fire behavior and proper firefighting techniques and safety and helps local fire departments with large wildland fires. The program assists in long-range planning for rural fire departments, including recommendations to improve fire prevention and suppression capabilities and to lower fire insurance premiums for commercial and residential property. The program also promotes fire prevention through educational materials to fire departments and schools.

The agency is working to map the wildland-urban interface between developed areas and wildlands, where wildfires can cause the most property damage. Mapping of the wildland-urban interface could enable subsequent efforts to identify landholders in these areas, provide them with wildfire mitigation educational materials, and promote local codes and regulations for enhancement of wildfire prevention and mitigation. This mapping should help with the data limitation noted in the risk assessment in Section 3.3.20 Wildfire.

Mitigation-Related Programs and Planning

Community Forestry Program- This program provides assistance, education, and support to communities and municipalities in organizing urban and community forestry programs, identifying resource needs, setting priorities of work, and training city employees.

Conservation Tree Planting Program- The tree-planting program provides tree and shrub seedlings for conservation plantings to enhance forest cover by providing increased forestation.

Environmental Education- The agency provides public education regarding the benefits of forestation through sponsorship of Project Learning Tree for grades K-12 and participation in the Kansas Association for Conservation and Environmental Education.

Firewise Program- The Kansas Firewise program offers prevention materials for homeowners to reduce the threat of wildland fire in rural and high-risk areas. There is currently only one Firewise community in Kansas.

Forest Pest Management- This program monitors the impacts of insects and diseases in woodlands and conservation tree plantings and recommends control measures for insect and disease problems.

Forest Stewardship Program- The forest service develops detailed comprehensive management plans for timber harvest, stand improvement, water quality, wildlife, soil erosion, recreation, and tree planting with emphasis on riparian forest management and windbreak establishment.

Kansas Wildland Fire Interagency Agreement- This document forms an agreement and commitment to fire management assistance and cooperation among the State of Kansas, Kansas State University on behalf of the Kansas Forest Service, the Kansas Department of Wildlife and Parks, the Kansas Division of Emergency Management, and the U.S. Department of Agriculture Forest Service and other federal agencies.

Landowner Education- The agency provides information and education to farmers regarding the benefits of good forest management. This includes information about including State Water Resources Cost Sharing, Environmental Quality Incentives Program practices, Conservation Reserve Program, Forestry Incentives Program, and the Riparian and Wetland Protection Program.

Rural Fire Protection- The agency provides forest support services to volunteer fire departments, including wildfire training, Smokey Bear fire prevention materials, and the acquisition and distribution of excess military vehicles for conversion to firefighting units.

Kansas Geological Survey

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The Kansas Geological Survey is housed in the University of Kansas and has sections for geohydrology (groundwater, aquifers); geology (mapping, resources, and hazard studies); energy (oil and gas data); and geophysics (subsurface exploration). The geological survey has produced reports on earthquakes, land subsidence, landslides, and other hazard-related topics. One of its principal responsibilities for the KHMT is to make technical data and analyses available to other state agencies. The agency is involved in a landslide-mapping project of rapidly developing areas around Kansas City as a pilot project. The intent is to produce maps delineating geologic hazard areas for the Kansas portions of the Kansas City metropolitan area.

Mitigation-Related Programs and Planning

High Plains Aquifer Information Network (HIPLAIN) - This joint effort between the Kansas Geological Survey and Kansas State University is dedicated to providing information, data, and resources related to the High Plains aquifer.

Information Collection and Dissemination- The Kansas Geological Survey develops and hosts web-based information retrieval systems to allow access to water-related data accumulated since 1975.

Ogallala Aquifer Study- The Kansas Geological Survey conducts research on the extent and characteristics of the groundwater resources to better plan to meet future water needs.

Surface Water Groundwater Interactions- This program develops integrated computer models for surface water and groundwater hydrology, develops hydraulic characterizations of the stream-aquifer interface, and studies the physical and chemical processes of stream-aquifer interactions in the middle Arkansas River subbasin and the Walnut River basin.

Water Resource Sustainability and Aquifer Recharge- This program develops documents and informational resources addressing the issue of the sustainability of water resources, the safe yield of aquifers, and the rate of aquifer recharge.

Kansas Highway Patrol

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The Kansas Highway Patrol (KHP) has an Emergency Operations Section that is responsible for the emergency preparedness functions assigned to the agency. Under the Kansas Response Plan, the KHP is the lead agency for Emergency Support Function (ESF #13 Public Safety and Security) and provides support to other ESF functions. The KHP has been working closely with the Kansas Department of Health and Environment on the Strategic National Stockpile and Pandemic Flu Planning. Also, the KHP has been working with the Kansas Animal Health

Department in creating a plan to stop the movement of livestock and agricultural products across state lines during a foreign animal disease outbreak. The KHP is also closely involved with the radiological emergency preparedness planning activities for the Wolf Creek Nuclear Power Plant.

The Kansas Highway Patrol also monitors hazardous materials transportation on highways, operates a vehicle safety inspection program for hazardous materials transporters, and maintains a database with the derived information. The KHP has been tasked by the governor to be the lead administrative agency for the state‘s activities under the U.S. Department of Homeland Security Grant Program.

Mitigation-Related Programs and Planning

Emergency Operations Center Grant Program–
This program was designed to ensure that EOC facilities are fully capable of providing security, sustainability and interoperability to ensure the continuity of operations during a major disaster or emergency, up to $1,000,000.00 for new construction projects or up to $250,000.00 for renovation of Emergency Operations Centers. For FY 2010, the City of Wichita received $500,000.00.

Kansas State Fire Marshal’s Office

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The Kansas State Fire Marshal‘s Office works to protect the citizens of Kansas by reducing deaths, injuries, and property losses from fire, explosion, and hazardous materials through inspection, enforcement, regulation, investigation, hazardous materials incident mitigation, data collection, and public education. Key programs of this agency related to hazard mitigation are those in fire prevention and hazardous materials risk management and incident mitigation.

Mitigation-Related Programs and Planning

Fire Prevention Program- This program focuses on structural inspection to ensure compliance with the Kansas Fire Prevention Code. The Kansas State Fire Marshal‘s Office works with local jurisdictional authorities. In addition, the Fire Prevention Division regulates the storage of highly flammable materials; oversees businesses involved in selling fire extinguishers, alarms, and sprinkler systems; and regulates fireworks manufacturers and displays. The division also tracks annual school fire and tornado drills.

Hazardous Materials Program- The Hazardous Materials Division is charged with developing, training, equipping, and supporting 12 regional hazardous materials/weapons of mass destruction (WMD) response teams across the state. These teams support local first responders in hazardous materials incidents, accidents, and acts of terrorism. They provide training, planning, and analysis related to hazardous materials accidents/incidents and WMD events to help local facilities and local, state, and federal agencies before an event occurs. These teams

are trained in the Incident Command System, facility pre-planning (which includes performing vulnerability analyses), and coordination among local, state, and federal agencies. Many of these trained personnel serve on local emergency planning committees, providing expertise and assistance to numerous communities. The division coordinates with other state agencies for training and actual hazardous materials/terrorism response.

Kansas State Historical Society

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Kansas has over 1,000 sites listed on the National Register of Historic Places and 130 different sites listed on the state register of historic places. These are vulnerable to disasters and several have been damaged in past events. The Kansas State Historical Society has a Cultural Resources Division with a State Historic Preservation Office (SHPO) and Archeology Department. The society has established a designated disaster assistance staff for helping libraries after disasters, and works closely with volunteers from the Kansas Museums Association to help small museums mitigate damage to cultural resources following disasters.

In cooperation with the KSHS Archeology Department, the Kansas Data Access and Support Center (DASC) maintains a GIS coverage and associated database of over 14,000 recorded archeological sites and all National Register listings in Kansas, including the built environment. The SHPO recently launched the Kansas Historic Resources Inventory online database, which contains approximately 50,000 buildings, structures, and sites. The SHPO is currently contracting with DASC to create a GIS from this database. The SHPO has responsibility for the historic review of structures to be removed from floodplains in flood mitigation programs. The SHPO also has responsibility for the Heritage Trust Fund, a grant program for the rehabilitation of historic buildings on the state or national register. Currently, over $1 million is expended annually with a required 20% local match. Window and roof repairs are commonly funded projects because it is the intent of the program to keep a "sound envelope" for the historic structure. These grant funds are often consolidated with other funding sources, such as state and federal rehabilitation tax credits.

Kansas State University Extension Service

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The Kansas State University Agricultural Experiment Station and Cooperative Extension Service have personnel in 105 county offices, nine experimental fields, five area offices, three research centers, and three research extension centers. These services deliver educational programs and technical information to enhance the economic viability and quality of life in Kansas communities. Mitigation-related responsibilities include research and education, community and economic development, and environmental protection. The educational and technical skills that the organization can deliver throughout Kansas at the community level are very important to the implementation of the Kansas Hazard Mitigation Plan.

Mitigation-Related Programs and Planning

Natural Resources and Environmental Management Program- The research and extension service works to protect the environment and conserve natural resources, particularly soil and water, by providing information about conservation techniques. The main emphases of the program are to ensure quality and conservation of surface water and groundwater, promote community and residential environmental management, and develop systems for improved soil and air quality.

Kansas Water Office

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The Kansas Water Office develops and maintains the Kansas Water Plan, monitors drought, chairs the Governor‘s Drought Response Team, and sells water from state-owned storage in federal reservoirs to municipal and industrial water users. Water releases from storage operated by the Kansas Water Office also helps members of three water assurance districts in meeting their water supply needs during periods of low flow.

The Kansas Water Authority is part of the Kansas Water Office and is responsible for advising the governor, the legislature, and the director of the Kansas Water Office on water policy issues; for approving the Kansas Water Plan and revisions thereto; and for approving water storage sales, federal contracts, administrative regulations, and legislation proposed by the Kansas Water Office.

Mitigation-Related Programs and Planning

Assessment and Evaluation- The Kansas Water Office assesses water resource conditions and assists in identification of priority areas to target state financial and technical assistance and to provide a baseline, against which progress in meeting objectives can be measured.

Drought Monitoring- The Kansas Water Office monitors drought-using guidelines approved by the Kansas Water Authority. When drought conditions exist within the state, the Kansas Water Office informs the governor and recommends assembly of the Governor‘s Drought Response Team. A periodic Kansas Drought Report is prepared and posted on the website of the Kansas Water Office.

Governor’s Drought Response Team- This team, chaired by the Kansas Water Office, is responsible for implementing an interagency state response to drought that is properly coordinated with local and federal response activities at all drought stages. An operations plan spelling out team membership, leadership, and procedures was approved by the governor in 2003. It identifies individual agency responsibilities at three drought stages.

Drought Response Team Operations Plan- This operations plan outlines a phased approach to drought response keyed to three county drought stages declared by the governor: watch,

warning, and emergency. Specific agency actions to be taken at each stage are identified. The Kansas Water Office developed the operations plan with input from state and federal agency members of the response team.

Kansas State Water Plan- The Kansas Water Office develops and maintains a comprehensive state water plan, which is approved by the Kansas Water Authority. The Kansas Water Plan addresses the management, conservation, and development of the water resources of the state. It involves all water-related agencies and is organized into policy and basin sections. Twelve basin advisory committees provide advice to the director and the Kansas Water Authority in this regard. The State Water Plan Fund is dedicated to implementing recommendations made in the Kansas Water Plan.

Public Information and Education- This public education program provides information on water resource issues to the general public through publication of articles, pamphlets, news reports, etc. It also provides support for environmental education and local leadership development programs.

Stream Gaging Program- State financial assistance is provided for the operation of selected gaging stations operated by the U.S. Geological Survey. These gages provide real-time stream flow data to facilitate decision making regarding water rights, minimum desirable stream flows, flood monitoring, reservoir management, and water quality monitoring and analysis.

Technical Assistance to Water Users- This program provides technical assistance to municipalities, irrigators, and other groups to assist in the reduction of water use and improve water use efficiency.

Water Assurance Program- This program augments stream flow during periods of low flow through releases from water supply storage in federal reservoirs to satisfy downstream water rights during drought conditions. The authorizing legislation allows municipal and industrial water right holders to form assurance districts and contract with the state for service from the federal reservoirs. Three water assurance districts have been formed by water users on the Kansas River, Marais des Cygnes River, and the Neosho-Cottonwood Rivers.

Water Conservation Program- The Kansas Water Office has developed guidelines for irrigation and municipal water conservation plans and practices. Municipal guidelines, revised in 2007, address drought response in addition to long-term water conservation.

Water Marketing Program- Through this program, the state sells water to municipal and industrial water users from state-owned water storage facilities in 13 federal reservoirs. Revenues repay the costs of the water supply storage space, operations, and maintenance to the federal government. The Kansas Water Office contracts with municipal and industrial water users wishing to obtain water from this storage. Contracts are approved by the Kansas Water Authority. There are presently 32 contracts for water from this storage. Some users have more than one contract and some sell treated water at wholesale prices to other water systems.

Water Supply and Demand Estimates- These estimates provide a consistent set of long-range population and water demand projections for planning purposes. Projections by county and public water supplier were made in 1998 for the years 2000, 2010, 2020, 2030, and 2040. These projections are being updated on an as needed basis.

Weather Modification- The Kansas Water Office regulates weather modification activities in Kansas through licensing of weather modification operators and permitting specific weather modification projects. The focus is hail suppression and reduction of damage from hail.

State Conservation Commission

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The State Conservation Commission (SCC) works with the 105 local conservation districts, the 88 organized watershed/drainage districts, and state and federal agencies to administer programs that improve water quality, reduce soil erosion, conserve water, and reduce flood potential. Mitigation-related responsibilities include: local government grants and loans, community and economic development, infrastructure construction/maintenance, property acquisition, environmental protection, and natural resource development and use. The U.S. Department of Agriculture Natural Resources Conservation Service provides the majority of the technical assistance. Local government administration is provided by the conservation districts. The SCC's programs for financial assistance in water resources protection are an important implementation component of the Kansas Hazard Mitigation Plan.

Mitigation-Related Programs and Planning

Multipurpose Small Lakes Program- This program provides state cost-share assistance to a government entity for the construction or renovation of a dam for flood control and water supply and/or recreational purposes. It requires a general plan of works and a local nonpoint source pollution control plan.

Nonpoint Source Pollution Control- The SCC distributes funding for implementation of local nonpoint source pollution management plans and supports the installation of best management practices involving sediment control, abandoned water well plugging, nutrient and pesticide management, household waste disposal, livestock waste systems, onsite waste systems, dump site reclamation, and chemical containment. The agency provides cost shares to local landowners for practice implementation, supports local technical assistance, and provides funding for local no till information and education programs.

Riparian and Wetland Protection Program- This program is meant to financially assist and address the conservation and management of riparian areas and wetlands. Financial assistance is provided to implement practices such as tree planting, riparian fencing, wetland enhancement, and other innovative bioengineering practices.

State Assistance to Watershed Dam Construction- The state provides cost-share assistance to organized watershed districts and other special purpose districts for the implementation of structural and nonstructural practices that reduce flood damage. Structural practices must be approved by the chief engineer of the Division of Water Resources.

Water Quality Buffer Initiative- This program provides additional incentive for participation in the Continuous Sign-Up provision of the U.S. Department of Agriculture Conservation Reserve Program. The program supplements the federal rental payments for the Conservation Reserve Program by 30% for grass filter strips or 50% for riparian forest buffers.

Water Resources Cost Share Program- This program provides state cost-share assistance to landowners for the establishment of enduring water conservation practices to protect and improve the quality and quantity of Kansas water resources. This includes targeting water quality funds to address total maximum daily load and other issues in priority areas, continuing base level funding to address water resource problems, technical assistance funding to landowners to implement best practices, and maintaining the irrigation efficiency focus in western Kansas.

Water Conservation Program- This program provides financial incentives for voluntary retirements of private water rights in areas that have been identified as hydrologically suitable. The Water Transition Assistance Program (WTAP) and the Conservation Reserve Enhancement Program (CREP) are two projects currently operating in approved target areas. Only those water rights, which can result in significant water conservation benefits to the state‘s rivers, streams, and aquifers are selected for these grants.

Watershed Planning Assistance Program- The commission provides financial assistance for engineering and environmental services, general plan development, and other flood control and rehabilitation projects in watershed districts.

Water Supply Restoration Program- This program provides financial assistance to renovate and protect lakes, which are used directly as a source of water for public water supply systems, where appropriate, and where watershed restoration and protection practices are planned or in place. Eligible sponsors include any entity with taxing authority and the right of eminent domain, rural water districts, and public wholesale water supply districts.

Watershed Restoration and Protection Strategy

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The Kansas Watershed Restoration and Protection Strategy (WRAPS) offers a framework that engages citizens and other stakeholders in a teamwork environment aimed at protecting and restoring Kansas watersheds. The WRAPS framework consists of identifying watershed restoration and protection needs, establishing watershed goals, creating plans to achieve established goals, and implementing plans. Each watershed served by a WRAPS team completing the program framework is eligible for WRAPS grant funding. The WRAPS funds are administered by the Kansas Department of Health and Environment in collaboration with an interagency Work Group, which consists of representatives from a number of state and federal agencies.

Table 4.3 2010 Technical Capabilities of State Agencies

	Agriculture Data Gathering/ Analysis	Demographic Data Gathering/ Analysis	Economic Analyses	Energy Resource Regulation	Environmental Data Gathering/ Analysis	GIS Data Management	Historical/ Cultural Resource Analyses	Natural Resource Management/ Planning	Risk Analysis and Management	State Property Information and Management
Adjutant General's Department		✓	✓		✓	✓			✓	
Kansas Division of Emergency Management		✓	✓		✓	✓			✓	
Data Access and Support Center						✓				
Animal Health Department						✓				
Kansas Corporation Commission			✓	✓	✓	✓			✓	
Division of Facilities Management			✓							✓
Kansas IT Office		✓	✓		✓	✓				
Department of Agriculture	✓	✓	✓		✓	✓		✓	✓	
Division of Water Resources					✓	✓		✓	✓	
Department of Commerce		✓	✓		✓					
Bureau of Environmental Remediation					✓	✓		✓	✓	
Center for Public Health Preparedness						✓				
Department of Labor			✓						✓	
Department of Transportation		✓			✓	✓			✓	
Kansas Forest Service					✓	✓		✓	✓	
Kansas Geological Survey					✓	✓			✓	
Kansas Highway Patrol						✓				
Kansas State Fire Marshal _sOffice					✓				✓	
Kansas State Historical Society						✓	✓			
Kansas State University Extension Service		✓	✓		✓	✓		✓	✓	
Kansas Water Office		✓			✓	✓		✓	✓	
State Conservation Commission								✓		

Table 4.4 2010 Implementation Capabilities and Local Mitigation Support Capabilities of State Agencies

	Implementation Capabilities								Local Mitigation Support Capabilities			
	Audits/ Code Enforce-ment	Information Management	Inspection	Project Engineering/ Design	Project Funding	Project Operations/ Maintenance	Project Permitting/ Licensing	State Water Planning	Grants and Loans	Regulatory Guidance/ Control	Technical Support	Training and Education
Adjutant General's Department		✓	✓		✓				✓		✓	✓
Kansas Division of Emergency Management			✓		✓				✓		✓	✓
Data Access and Support Center		✓									✓	✓
Kansas Corporation Commission	✓		✓	✓			✓			✓		✓
Division of Facilities Management			✓	✓	✓	✓	✓					
Kansas IT Office		✓									✓	
Department of Agriculture	✓		✓						✓	✓	✓	✓
Division of Water Resources	✓		✓	✓			✓			✓	✓	✓
Department of Commerce					✓				✓	✓	✓	✓
Bureau of Environmental Remediation	✓	✓	✓							✓	✓	
Center for Public Health Preparedness		✓										
Department of Labor			✓								✓	
Department of Transportation			✓	✓	✓	✓	✓		✓		✓	✓
Kansas Forest Service			✓						✓		✓	✓
Kansas Geological Survey									✓		✓	✓
Kansas Highway Patrol	✓		✓		✓				✓	✓	✓	✓
Kansas State Fire Marshal's Office	✓		✓		✓				✓		✓	✓
Kansas State Historical Society									✓			✓
Kansas State University Extension Service								✓			✓	✓
Kansas Water Office					✓		✓	✓			✓	✓
State Conservation Commission					✓				✓		✓	✓

4.2.2 State Policies and Regulations

This section provides an update to the identification of state statutes that are applicable to the mitigation program. Table 4.5 shows the state statutes that address hazard mitigation programs in the state most directly. The mitigation plan is intended to be consistent with and supportive of these policies.

Table 4.5 Kansas Statutes Applicable to the State Mitigation Program

Statute	Hazards Addressed	Purpose
Small Dam Safety and Rehabilitation Policy (K.S.A. 82a-301et seq.)	Dam Failure	In January 2009, the Kansas Water Authority approved a Kansas Water Plan policy section titled Small Dam Safety and Rehabilitation. It made 21 recommendations addressing the issues of establishing a cost share program, catastrophic repair eligible, and inundation map preparation eligible, but does not include routine operation and maintenance or limit dam owner liability.
Dam Identification Regulations (K.S.A. 2007 Supp. 82a-303a)	Dam Failure	The state enacted new regulations for dams in May 2007. The regulations now require class B (significant) hazard dams to prepare emergency response plans on a form prescribed by the chief engineer of the Division of Water Resources. This plan should include a map or written description of the area that could be inundated by a breach (as described in the regulation). As of 2010 they are still trying to complete all the plans for the significant hazard dams. The requirements for high hazard dams did not change. Additionally, the definitions of the hazard classes for class A, B, and C dams were changed (see Section 3.3.2 Dam and Levee Failure).
Conservation Districts Chapter 2, Article 19	Soil Erosion, Drought	Establishes the State Conservation Commission and the authority to establish 105 County Conservation Districts; each district with a board of five supervisors responsible for overseeing conservation activities, evaluating local practices, suggesting and overseeing the implementation of mitigation measures deemed necessary, offering financial and other assistance, and taking appropriate actions that would be needed to enforce any laws relating to conservation.
Soil erosion caused by wind Chapter 2, Article 20	Soil Erosion	Charges individual landowners with practicing appropriate erosion preventive measures; makes it the duty of the Secretary of Agriculture to collect data, offer solutions to erosion causing conditions, and report conclusions to local and state government officials and the general public; and requires County Commissions to enforce erosion prevention practices as well as to take proper action to correct or mitigate potential erosion causing conditions.
Planning and Zoning Chapter 12, Article 7	Multi-Hazard	Allows local governments to establish planning commissions and to adopt zoning regulations and comprehensive development plans.
Planning and Zoning Chapter 12, Article 7	Multi-Hazard	Prevents governing bodies from enacting zoning laws that exclude manufactured housing.
Planning and Zoning Chapter 12, Article 7	Flood	Allows cities and municipalities to designate floods zones and restrict the use of land within these zones, require that any local ordinances relating to flood zones be approved by the chief engineer of the Division of Water Resources of the State Board of Agriculture before adopting such ordinances, and require compliance with the Flood Insurance Act of 1968.
Flood Control Chapter 19, Article 33	Flood	Allows cities and counties to develop stormwater management and flood control projects and programs, provide local funding, and enter into agreements with other agencies to develop and use flood control works.
Flood Control Chapter 19, Article 33	Flood	Allows for a county sales tax to provide funding for stormwater and flood control improvement, and county and city governments to enter into

Statute	Hazards Addressed	Purpose
		agreements for development of flood control projects.
Watershed Districts Chapter 24, Article 12	Soil Erosion, Flood	Establishes watershed districts and outlines how they will be established and operate.
Drainage Districts within Counties and Cities Chapter 24, Article 4	Flood	Allows the development of drainage districts of 160 acres or more involving several landowners for, in part, taking actions to protect property from floods, including raising funds and constructing flood control works such as levees or retention dams. Also allows districts to develop an emergency fund to respond to imminent danger, such as from a threatening flood.
Public Improvements Chapter 13, Article 10	Flood	Allows first class cities to construct stormwater projects to prevent localized flooding.
Chapter 19, Article 26	Multi-Hazard	Allows local governments to trim trees that may be a hazard away from local power lines.
Fire Safety and Prevention Chapter 31, Article 1	Wildfire, Tornado	Establishes the Office of the State Fire Marshal and outline its duties as well as the role the state will play in fire safety and prevention.
Fire Insurance Companies and Mutual Fire and Tornado Companies Chapter 40, Article 9, 10	Winter Storm, Tornado	Article 9 allows insurance companies to include freezing rain in insurance policies. Article 10 allows insurance companies to sell insurance for tornadoes, among other hazards.
Protection of Domestic Animals Chapter 47, Article 6	Agricultural Infestation	Provides the Livestock Commissioner authorities to develop regulations for control of disease spread among animals and to impose quarantines and other control measures.
Kansas Emergency Management Act Chapter 48, Article 9	Multi-Hazard	Creates the Division of Emergency Management under the direction of the Adjutant General and outlines the emergency management responsibilities and capabilities of the Adjutant General. Appoints the governor as the Commander-in-Chief of the organized and unorganized militia and all other forces available for emergency duty as well as giving the governor the power to declare a state of disaster emergency and direct emergency operations. Directs the Division of Emergency Management to formulate a statewide emergency plan and outlines the duties of the division. Requires counties to establish and maintain a disaster agency responsible for emergency management, prepare a county emergency response plan, and coordinate efforts with the division. Establishes the Kansas Nuclear Safety Emergency Management Act.
Emergency Planning and Community Right-to Know Act Chapter 65, Article 57	Hazardous Materials	Establishes the state emergency response commission and its duties for the purpose of providing assistance in the coordination of state agency activities relating to: chemical emergency training, preparedness, and response; and chemical release reporting and prevention, transportation, manufacture, storage, handling, and use.
Kansas Underground Utility Damage Prevention Act Chapter 66, Article 18	Multi-Hazard	Promulgates regulations for utility damage prevention.
Roads and Bridges Chapter 68, Articles 9 and 15	Flood	Controls the damming of water courses.
Kansas Water Office and Kansas Water Authority Chapter 74, Article 26	Drought	Requires that the Kansas Water Office with Kansas Water Authority approval shall establish guidelines for monitoring drought conditions. When drought conditions exist within the state, the governor is to be notified, and assembly of the Governor‘s Drought Response Team recommended.

Statute	Hazards Addressed	Purpose
Architectural Services Chapter 75, Article 12	Tornado	Requires mobile homes to have appropriate foundations, —tie downs," and roofs as well as to comply with national standards for manufacture.
Department of Health and Environment Chapter 75, Article 56	Multi-Hazard	Provides for the development of local environmental protection plans to support implementation of the environmental protection strategy of the state water plan. Also, provides for local environmental planning grants.
Navigable Waters, Obstructions in Streams, and Collection, Storage, and Impounding of Waters Chapter 82a, Articles 2,3, and 4	Flood, Drought, Dam Failure	Governs the regulations and supervision of dams and other water obstructions and ensures public safety from dam failure.
Water Districts Chapter 82a, Article 6	Drought	Allows the establishment of water supply districts.
State Water Resources Planning Chapter 82a, Article 9	Flood, Drought	Establishes long-range goals and objectives for the management, conservation, and development of the waters of the state and policies deemed desirable for their achievement. Stipulates considerations to be used in formulating the State Water Plan and establishes the State Water Plan Fund.
Groundwater Management Districts Chapter 82a, Article 10	Drought	Establishes special districts for the proper management and conservation of the groundwater resources of the state.
Groundwater Exploration and Protection Act Chapter 82a, Article 12	Drought	Provides for the exploration and protection of groundwater through the licensing and regulation of water well contractors in Kansas to protect the health and general welfare of the citizens of this state, to protect groundwater resources from waste and potential pollution, and to provide data on potential water supplies that will permit the economic and efficient utilization and management of the water resources of the state.
Weather Modification Act Chapter 82a, Article 14	Hailstorm, Drought	At the direction of the Kansas Water Authority, the director may issue licenses to weather modification operators and permits for weather modification activities, as provided for in this act.

The assessment of state policies and regulations is done to evaluate the strength of the state policy framework in light of the hazards that threaten the state, to identify conflicts or inconsistencies in policies that may erode their effectiveness, to evaluate the capabilities of state policies to encourage and improve hazard mitigation capabilities at the local level, and to identify mitigation-related policies that could be used in a more coordinated manner to more effectively achieve the mitigation goals and objectives of the state.

4.2.3 State Funding Capabilities

The ability to fund mitigation-related efforts is a key component of the mitigation capabilities of the state. The primary source of mitigation funding is through the state's administration of FEMA's Hazard Mitigation Grant Program (HMGP) (see Section 4.5 Funding Sources for more information about this and other FEMA grant programs). Currently most of the HMGP funds from past disasters have been allocated to communities for mitigation projects. KDEM is looking at using the PDM and FMA programs more in the future. The state also has a variety of nonfederal funding and incentive programs to support mitigation in Kansas. One way the state funds mitigation is through the program budgets for mitigation-related state agency programs.

In addition, the State Water Plan Fund is entirely nonfederal and is supported from Kansas General Revenues, state gaming receipts, and fees imposed on water users. It generates approximately $20-21 million per year and is used to implement recommendations in the Kansas Water Plan. Specific projects vary year by year. Budgets direct funds to various state agencies for program activities and specific projects, often to be completed through contracts with local, state, or federal agencies or to complete needed data collection, studies, or construction by subcontractors. Annual allocations are a result of Kansas Water Authority recommendations, the governor's budget recommendations, and the legislative budget process. State agency mitigation-related efforts concerning water availability and management of flood hazards are included.

The following other state financial assistance or incentive programs were described in Section 4.2.1 State Agencies and Mitigation-Related Programs; most are focused on flood and drought hazards:

- Kansas Partnership Fund (Kansas Department of Commerce)
- Water Quality Buffer Initiative (State Conservation Commission)
- Water Resources Cost Share Program (State Conservation Commission)
- Water Rights Purchase Program (State Conservation Commission)
- Watershed Dam Construction Assistance (State Conservation Commission)
- Watershed Planning Assistance Program (State Conservation Commission)
- Multipurpose Small Lakes Program (State Conservation Commission)

In 2007, the state legislature appropriated money (for fiscal year 2008) to help pay local match requirements for mitigation planning grants and projects associated with HMGP funds. In December 2009, this program closed and 104 of the 105 counties were approved for funding to complete their hazard mitigation plans. Wallace County was the only county that did not apply for funds to complete a hazard mitigation plan.

4.2.4 Changes in Capabilities since 2007

This section highlights key changes in the capabilities of the state since approval of the previous plan.

Legislation and Policies

- In January 2009, the Kansas Water Authority approved a Kansas Water Plan policy section titled "Small Dam Safety and Rehabilitation." It made 21 recommendations addressing the issues of establishing a cost share program, catastrophic repair eligible, and inundation map preparation eligible, but does not include routine operations and maintenance or limit dam owner liability.
- The state enacted new regulations for dams in May 2007. The regulations now require class B (significant) hazard dams to prepare emergency response plans on a form prescribed by the chief engineer of the Division of Water Resources. This plan should include a map or written description of the area that could be inundated by a breach (as described in the regulation). As of 2010, they are still trying to complete all the plans for the significant hazard dams. The requirements for high hazard dams did not change. Additionally, the definitions of the hazard classes for class A, B, and C dams were changed (see Section 3.3.2 Dam and Levee Failure).

- The Kansas Corporation Commission has required that electric and gas utilities under their jurisdiction file their emergency plans with the agency, that the utilities emergency contact list is kept up-to-date, and that the utilities review their emergency plans on a regular basis with employees.
- The Kansas Water Authority and Kansas Water Office initiated a strategic planning effort aimed at facilitating a more proactive approach to emerging long-range issues. Initial emphasis is being placed on sediment and surface water management. A key component is assessing future demand for water from state-owned water supply storage in federal reservoirs and the impact that sediment deposition will have on water availability. This is being done within the context of a 2% (50-year) drought, such as was experienced during the 1950s. Future statutory changes or changes to reservoir operations policy are possible outcomes of this effort. KWO is using the OASIS model to simulate a 2% drought to quantify demand and water availability. The input to the model is complete and is updated periodically. This is included in the work for the Reservoir Sustainability Initiative. This initiative looks at the effects of sediment on the water supply reservoirs statewide, and then basin by basin. The Neosho basin is the only basin that has been completed as of January 2010. The Verdigris basin is scheduled next. On May 3, 2010, Kansas filed suit in the U.S. Supreme Court to enforce the final settlement stipulation. Nebraska may have violated the 1943 Republican River compact by overuse of the river waters and has failed to take actions necessary to avoid future violations, especially in the inevitable dry periods to come.
- In 2007, the state legislature appropriated money to fund the local match requirements for counties receiving mitigation planning grants through the Hazard Mitigation Grant Program. As of April 2010, all 105 counties with the exception of Wallace County, have been approved, been funded, or approved for funding to complete a hazard mitigation plan. The program closed in December of 2009 for the State of Kansas to meet the match for the community.
- The Kansas Subsidence Insurance House Bill No. 2099 was introduced to the state legislature in 2007. HB 2099 was approved by the house and senate and then signed by Governor Parkinson in May of 2010. It would create a mine subsidence insurance association, a mine subsidence insurance governing board, outline their duties and responsibilities, as well as create a mine subsidence insurance fund.

Agency Roles and Responsibilities

- In 2010, there are 67 state agencies in various stages of developing continuity of operations plans. All 105 counties have the opportunity to develop a COOP plan; however, county training just begun in October 2009 and details of how many will develop the plans is unknown at this time. To date, over 1000 individuals have been trained on COOP planning from both public and private sectors. The goal is to have these plans completed within a year.
- The mitigation-related roles and responsibilities of state agencies have been more clearly defined by the governor‘s approval of the Kansas Response Plan in September 2006. As of April 2010 the Kansas Response Plan is being updated and is approximately 80% completed.
- KDEM continues to manage the FEMA mitigation grant programs for HMGP, PDM, and FMA. The only exception is the Emergency Operation Center grants that are currently being

managed by the Kansas Highway Patrol Department. KDEM is still using HMGP monies to pursue mitigation of repetitive and severe repetitive flood loss properties. KDEM has not used FMA funds. In conjunction with the state National Flood Insurance Program (NFIP) coordinator, KDEM will continue to inform and educate jurisdictions about the NFIP and mitigation efforts to reduce property impacts within flood hazard areas. Additionally, as the new requirements for local multi-hazard mitigation plans are mandated to include FMA criteria, the state may pursue FMA grants for interested communities as part of their flood mitigation strategy.

- The Kansas Corporation Commission is working with Kansas Municipal Utilities to develop mutual assistance agreements. In addition, the commission assisted the municipal utilities in getting grant money to develop a Municipal Mutual Assistance Plan in Kansas.

Funding Sources

- The KHMT indicated that some grants formerly available through the U.S. Department of Homeland Security designed to improve capabilities in planning, equipment, training, and exercises, had significantly decreased from recent disasters throughout the United States and abroad.
- Because of disaster declarations in 2008, 2009, and 2010, the State of Kansas received approximately $62.5 million in Hazard Mitigation Grant Program funding for mitigation planning and projects (see Section 4.5.5 Funding for Mitigation Actions 2004 to 2010).
- KDEM is currently looking at using PDM and FMA Grant Programs since HMGP funding has been allocated to communities from past disaster declarations and funding remains minimal in the HMGP programs that the state still has open.

4.2.5 Assessment of Opportunities for Improvement

This section highlights policies and programs that have been effective in achieving mitigation objectives and actions in Kansas and discusses opportunities for improving state mitigation capabilities. The KHMT used a small group brainstorming process to identify the strengths and weaknesses in the state‘s mitigation capabilities, and the opportunities and obstacles to improving mitigation capabilities. Several themes emerged from this process and are summarized below. Ranking of mitigation actions was also included in the meetings. More details on this process and results are included in Appendix L Themes from Small Group Process on Capabilities.

Interagency Coordination

The KHMT identified interagency coordination as an obstacle to improving state capabilities, specifically related to planning efforts and sharing information and technical data. The long-term effectiveness of the state‘s mitigation program is contingent on using existing mitigation-related programs in as coordinated and integrated manner as possible to achieve the maximum benefits to statewide capabilities. As part of the 2010 planning process, the KHMT agreed to continue to have quarterly meetings to better facilitate interagency coordination.

Sharing agreements continued to be in place by state agencies. The state capability assessment identified the following opportunities for coordinating the implementation of different programs to enhance local mitigation capabilities:

- The programs of the Kansas Department of Commerce offer opportunities for incorporating mitigation into state-sponsored and funded efforts for community and economic development.
- The Water Quality Buffer Initiative of the State Conservation Commission could be used to expand the state's capabilities for land and property acquisition in the floodplain under the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.
- The Community Forestry Program of the Kansas Forest Service and its local training programs offer opportunities to provide information in local land use controls for minimizing wildfire vulnerability in the wildland-urban interface.

Financial and Technical Assistance to Local Governments

Table 4.3 indicates that many agencies provide support to local governments through training and education, grants and loans, and technical support:

- KDEM provides financial and technical assistance to counties for the development of local mitigation plans and for funding mitigation projects. KDEM also coordinates programs for local comprehensive emergency management planning and local mitigation planning to ensure that planning efforts are consistent and mutually supportive.
- The Kansas Department of Commerce administers community development programs, such as the Community Capacity Building Program and Kansas Partnership Fund, which can provide state assistance to local governments in a coordinated manner to ensure that mitigation considerations are incorporated into community development programs.
- The Kansas Department of Agriculture has several programs that are supportive of local government efforts, particularly in flood control and water availability. This includes the Division of Water Resources provision of technical assistance to communities with adopting, updating, and enforcing floodplain management regulations.
- The Kansas Water Office helps coordinate several programs supporting local flood control and drought mitigation actions through the Kansas Water Plan.
- The Kansas Department of Health and Environment has programs supporting local government efforts to respond to human disease outbreaks.
- The State Conservation Commission is responsible for programs focused on watershed development and protection.
- The Kansas Highway Patrol offers a grant program for communities to build or update emergency operation centers.

Opportunities exist for building state and local mitigation capabilities by expanding the state's capabilities for helping local governments meet nonfederal matching costs for mitigation-related projects and by improving the coordination and integration of state training programs for local officials with more emphasis on hazard mitigation. The greatest opportunities for improvement in

hazard mitigation in Kansas exist at the local level. Therefore, helping all communities develop and adopt local hazard mitigation plans is one of the state‘s top priorities.

Statewide Regulation and Enforcement

One important aspect of the state‘s mitigation policy framework is the requirement or encouragement of general actions by local governments to reduce vulnerability to disasters. Two such general actions are adoption and enforcement of building codes and comprehensive land use planning to manage growth in known hazard areas.

The Kansas State Legislature has not implemented a statewide building code nor does it require comprehensive planning by local governments. The state does not have a land use plan or specific plans for critical areas or those of special concern. The KHMT identified the lack of requirements in these areas as a weakness in the state‘s mitigation capabilities and found that additional statewide guidance and requirements in these areas offer opportunities to enhance mitigation capabilities at the local level. In addition, inadequate enforcement of existing regulations by the state was found to be an obstacle.

New regulations are not popular in Kansas, which is a home rule state. Home rule is the granting of powers from the central government of a state to governments at regional or local levels. The KHMT identified that distrust of state and federal government is common among residents. The KHMT did not believe that Kansas legislation in these areas will change in the near future but did identify opportunities to encourage local adoption of building codes and land use plans through promoting model codes and ordinances and providing guidance on integrating land use and mitigation.

Statewide Policy Framework for Floods

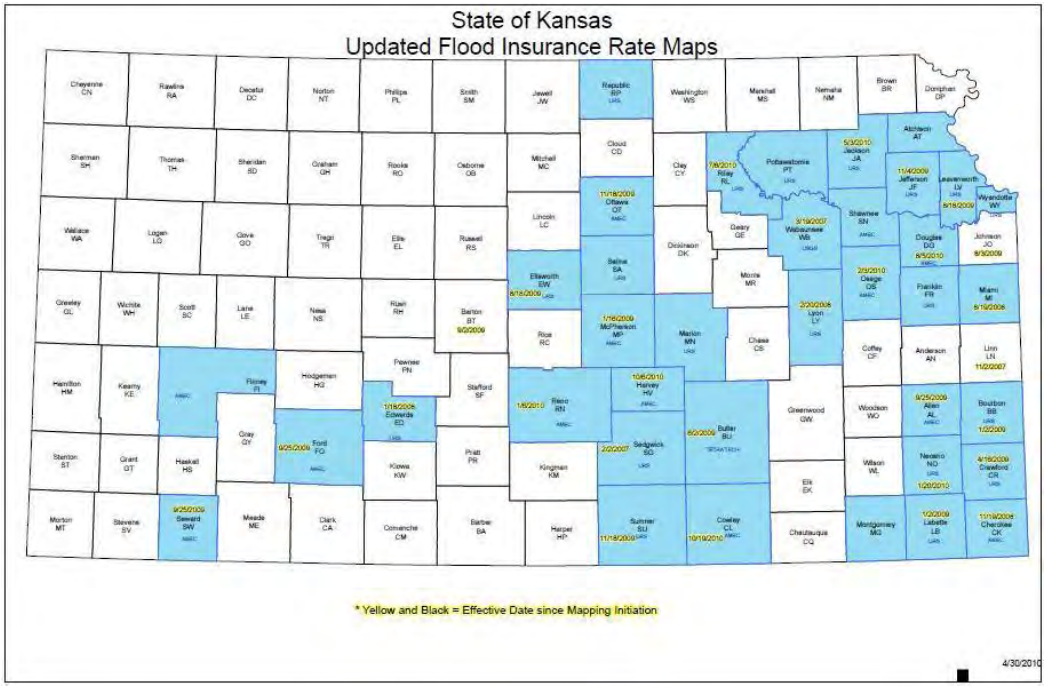
The Kansas Statutes Annotated addressed flooding at both the state and local level. The state statutes empower local governments to restrict development and redevelopment in the floodplain, to build and operate stormwater and flood control projects, to form watershed and drainage districts for better coordination of flood projects and operations, and to raise funds locally to accomplish these purposes. If local governments use the authorities granted to them by state statutes and policies, there is a strong policy framework for flood hazard mitigation in Kansas.

Kansas statutes passed in 1970 gave cities and counties zoning authority to help reduce floodplain problems. Those statutes were significantly revised in 1991. The Division of Water Resources reviews and approves floodplain-zoning ordinances prior to their adoption by local governing bodies and provides technical assistance to communities to help them develop proper floodplain-related ordinances. For floodplain management, incorporated cities and unincorporated areas of counties are separate entities that must separately enact and enforce floodplain management regulations.

Floodplain mapping is essential to administering local floodplain management programs. A total of 39 Kansas counties (according to the Kansas Water Plan) have been mapped for flood hazards as part of this program. New or updated maps are needed in many areas of Kansas.

The Division of Water Resources coordinates with FEMA on floodplain mapping priorities and provides limited state mapping assistance to local communities. Figure 4.1 shows the production status of digital flood insurance rate maps in Kansas as of April 30, 2010.

Figure 4.1 Status of Flood Map Modernization Program in Kansas



The State Water Resources Planning Act establishes a long-range goal to reduce damaging floods and losses resulting from floods and identifies policies for achieving this goal. The act also mandates the formulation of a state water plan and establishes the State Water Plan Fund. Significant funding from the State Water Plan Fund has been directed toward reducing flood vulnerability in priority watersheds in Kansas.

The KHMT identified that better communication and coordination between the water and emergency management communities is still needed. The Kansas Hazard Mitigation Plan and the Kansas Water Plan should also be more complementary. The Kansas Water Office is beginning the process of revising and updating the 12 basin plans that are part of the Kansas Water Plan. This provides an opportunity for the flood risk assessment in the mitigation plan to provide focus and targeting for consideration of flooding in the basin plans. The priority areas for rural flood damage reduction currently used in the basin plans were identified in the 1980s using data from as far back as the late 1960s.

The Kansas Water Plan is an appropriate place to address needed changes in state policy related to flooding. In addition to the basin plans, the Kansas Water Plan contains policy sections that make recommendations regarding the need for new or amendatory legislation, planning and coordination, and funding. The State Water Plan Fund is available to support implementation of recommendations made in the Kansas Water Plan.

The state has made the mitigation of repetitive flood loss and severe repetitive loss properties a priority, which is a national priority as well. The state had several tasks related to this in the previous plan (see Appendix M) and has made demonstrated progress in tracking and funding projects that mitigate repetitive loss properties. These tasks have been revised into a new action: ―Mitigate repetitive flood loss and severe repetitive flood loss structures" that is detailed in Appendix N. One of the completed actions from 2004 is the development of a database used to track mitigation projects involving repetitive loss properties and has been useful in the 2010 plan update. The availability of post-disaster funds and new pre-disaster federal funding sources for repetitive loss mitigation provide more opportunities for the state to address these issues (see Section 4.5.1 Federal Funding Sources for more detail).

In 2008, the state was arranging potential buy-outs of severe repetitive loss properties from interested jurisdictions. Specific jurisdictions are not identified at this time. Should these properties be successfully mitigated, the state's severe repetitive list and repetitive loss property list will be reduced. With the understanding that the repetitive and severe repetitive loss lists can change after a flood, DWR and KDEM will partner to continue outreach to communities that contain properties on these lists.

The Kansas Legislature appropriated funds to match the 25% required for a planning grant through HMGP, thus allowing all counties to develop multi-jurisdiction hazard mitigation plans. The state will require that jurisdictions will include information in their plans concerning NFIP participation as well as their repetitive and severe repetitive loss properties and how they intend to address them. As of 2010, 104 of the 105 counties participated in appropriating funds to compete a hazard mitigation plan and are now closed.

Data Needs and Capabilities

When assessing the state's technical capabilities, the KHMT identified problems with data consistency, quality, and accessibility. Conflicts are also created around the issue of which data is too sensitive to make public. Some progress is being made on this issue. The Geospatial Technology Section of the Adjutant General's Department has released a Kansas Geospatial Data Security Policy to help determine if a data layer or attribute data within the layer needs to be restricted. Information sharing and coordination among agencies is also a weakness.

The state has strong GIS capabilities, largely because of the efforts of the Kansas GIS Policy Board and DASC. The GIS Policy Board helps to develop standards, strategies, and policies that emphasize cooperation and coordination among agencies in GIS. DASC has begun a new program that allows local governments to back up GIS data at DASC for free. The collaborative effort between the GIS Policy Board and DASC—the Kansas Geospatial Community Commons allows state and local governments to share information and promote services and products.

The GIS Breakthrough Team formed through the Kansas Collaborative has completed a Guidebook for County GIS Implementation, which is available for downloading. In partnership with members of the state's GIS Policy Board, efforts are underway to create a statewide inventory of critical data layers at the local level. Pilot efforts are also underway in partnership with DASC to build a process for local verification and updates of statewide data layers.

Opportunities for improvement in data are in critical facilities, critical infrastructure, and state-owned and operated facilities. Information exists in different agencies and has not been

compiled into one location. Some data is out-of-date, information on local facilities is difficult to collect, and some information is not geospatially enabled. The KHMT also identified the need for state agencies to have a consistent and coordinated approach to collecting and archiving data after emergency events and is still an issue with the 2010 plan update.

State Staff Resources

State agencies along with KDEM identified inadequate staffing as an obstacle to strengthening state mitigation capabilities in the previous update. The problem was identified as most severe in KDEM, specifically within the mitigation section, where the KHMT noted that inadequate staffing resulted in lost opportunities. Since the previous update, KDEM has staffed its department and is currently up to adequate personnel. New staff members had to be trained on state and federal mitigation programs and procedures to adequately support the department on the ~~"d~~ay to day" functions.

State-Approved Watershed General Plans

In 2010, there were 86 organized watershed districts in Kansas that covered 22% of the state's land area. About 60% of districts have an active general plan according to the Kansas Water Plan. The Kansas Watershed District Act (KSA 24-1201 et seq.) was enacted in 1953 to provide a subdivision of state government with adequate powers to sponsor watershed projects developed with federal assistance. The act requires that a general plan identifying planned works of improvement eligible for state cost share, such as dams, be prepared and identify associated costs and benefits documented. The general plan is reviewed and approved by the chief engineer of the Division of Water Resources. These plans have traditionally focused on structural flood control measures; however, incorporating nonstructural measures into watershed plans, such as those being developed as part of the Watershed Restoration and Protection Strategy, could further enhance the reduction of damage from floods while also providing other benefits.

Tornado Safe Room Policies

One weakness of the state mitigation program may be that programs and funding are heavily centered on flood hazards. Currently, there are no policies, requirements, financial incentives, or other provisions to have tornado safe rooms instituted in public and private buildings. Only one identified state regulation, KSA Chapter 75, Article 12, requiring certain architectural standards for mobile homes, addresses tornado or high wind hazards.

Public Education Programs

Enhancing the scope and coverage of public education programs conducted by state agencies is an opportunity for improving state mitigation capabilities. In their evaluation, the KHMT discussed the lack of public awareness and understanding of hazards and vulnerabilities and a common attitude of apathy, such as ~~"it~~ won't happen to me."

Many agencies have the capability to provide public education and information programs. KDEM and local emergency management agencies participate annually in the National Weather

Service's Severe Weather Awareness Week in March. Area residents, businesses, schools, and emergency management agencies are encouraged to use Severe Weather Awareness Week as a springboard to preparing for the severe weather season. Enhancing participation in this and other seasonal awareness campaigns could also improve state mitigation capabilities. Because of funding and manpower issues the public education efforts have been slow. The state has been very active with continuing public education for severe weather working with the National Weather Service. When funding and manpower become available, the state intends to improve public education efforts of extreme temperatures, hazardous materials, wildfire, and outreach to special needs populations and communities in rural areas. Different state associations and community centers have been identified as potential partners in public awareness efforts; however, the economy has been a deterrent statewide.

Recent Disasters

Kansas has experienced eight presidential disaster declarations since 2007. Declarations in 2010 were for severe winter storms and snowstorms. In 2009 they were for severe storms, flooding, straight-line winds, tornadoes, and winter storms. And in 2008 they were for severe winter storms, severe storms, flooding, tornadoes, and record and near record snow. These disasters have increased the hazard awareness of the public, state agencies, and elected officials. State agencies worked together during recent disasters. In addition, available funding offers opportunities to implement planning and projects. The KHMT identified a current window of opportunity in which the political will exists to provide momentum behind mitigation planning and initiatives.

Source: FEMA News Photo Norton, KS

4.3 Local Capability Assessment

IFR REQUIREMENT 201.4(c)(3)(ii):	[The State mitigation strategy shall include]: a general description and analysis of the effectiveness of local mitigation policies, programs and capabilities.
Explanation:	The plan **shall** include a general description of local mitigation policies, programs, and capabilities. The State **shall** also describe how local pre- and post-disaster mitigation policies, programs, and capabilities, such as building codes, zoning, or land use policies, were evaluated to determine their effectiveness. This *should* include existing and emerging capabilities. The description can be kept general and does not need to be detailed for all localities. The State *should* include in its description the following: implementation opportunities and problems (e.g., financial /staffing resources, lack of informed public, non-mandated improvements, etc.), opportunities for building local capabilities, and problems created by public investment policies (e.g., policies that may have inadvertently promoted public investments in hazard-prone areas). The State *should* highlight local implementation tools, policies, and programs that have proven to be effective in achieving mitigation objectives (e.g., adoption of planning legislation requiring integration of mitigation actions in comprehensive plans).

Local capabilities are the existing programs and policies through which local governments implement mitigation actions to reduce potential disaster losses. The local capability assessment provides a general description of local mitigation capabilities in Kansas and their effectiveness for mitigation. The KHMT assessed the challenges and opportunities to implementing and strengthening local mitigation capabilities in Kansas through a small group brainstorming process. The key issues identified from this process and from reviewing capabilities identified in local plans are summarized below.

4.3.1 Local Policies, Programs, and Capabilities

There are a wide range of policies that can serve as a foundation for implementing local mitigation plans, including building codes, floodplain ordinances, zoning codes, and comprehensive land use plans. The state continues to encourage and authorize through state statute local adoption of these types of capabilities, but they are not required. Other types of capabilities that may be used to implement local mitigation actions include economic development plans, capital improvement plans, stormwater management plans, erosion management plans, environmental regulations, growth management plans, and hazard specific ordinances.

Local Emergency Management

The Kansas Emergency Management Act requires that each county maintain a disaster agency responsible for emergency preparedness and coordination of response to disasters. The statute also requires each county to maintain an emergency operations plan that has been approved by KDEM (see plan status below). The act is the basis for the state/local emergency management relationship, which is solidified by continued contacts and mutual assistance with day-to-day operations and during disaster response. The Kansas Planning Standards provide guidance to local governments in developing emergency operations plans.

Figure 4.2 Local Emergency Management Plans

Local Hazard Mitigation Plans

Federal regulations require local jurisdictions to prepare and adopt a local hazard mitigation plan approved by FEMA to be eligible for FEMA's Hazard Mitigation Grant Program and Pre-Disaster Mitigation program. The mitigation section of KDEM supports local hazard mitigation planning, administers funding programs, and reviews plans before submission to FEMA. There are forty FEMA-approved local hazard mitigation plans in Kansas. Therefore, out of 105 counties in Kansas, about thirty-eight percent have approved local hazard mitigation plans. Several other plans are at various stages of review and adoption. The majority of these local plans are multi-jurisdictional and cover incorporated communities and special districts.

Building, Fire, and Life Safety Codes

The State of Kansas does not have a statewide building code. State statutes do assign the fire marshal the responsibility of establishing reasonable and uniform regulations to ensure a minimum level of life safety. To meet the intent of the Kansas Fire Prevention Code and other statutory requirements, new construction and changes in building use are required to be under the direct supervision of a licensed design professional. It is also required to be designed and constructed to a criteria established by one of the three model building codes adopted by Kansas regulations, and either have plans reviewed for compliance to code intent or receive a building permit from a local building official with fire authority with building inspections during construction as well as receive a certificate of occupancy prior to formal use.

The state has adopted the 2003 International Building Code for all state-owned facilities. Thirty municipalities and four counties have adopted versions of the International Building Code. Several other communities have outdated versions of the uniform building code. Because of the well-established mitigation value of current building and fire safety codes, as well as land use

plans and codes, it would be desirable to have a greater percentage of the jurisdictions with these tools in place. These are benchmarks that can be monitored by the KHMT over time. Although no statewide regulations exist, guidance from the state, such as codes and ordinances, offers an opportunity to promote these tools.

Land Use and Comprehensive Plans

Cities and counties in Kansas are authorized by state statute KSA Chapter 12, Article 7, to establish planning commissions and to prepare and adopt comprehensive development plans but are not required to do so. These plans could be used to implement growth management in known hazard areas. Some communities have used this authorization to adopt comprehensive plans, but, without state requirements, many are out of date.

Currently, the state is able to track what comprehensive plans the counties and municipalities have through the COOP database. The county COOP plans are on going and will continue to be updated as new data is available for each community. When all COOP Plans and hazard mitigation plans are complete it is intended that these will eventually be connected to one another for ease in data collection and dissemination.

Floodplain Management

The potential for future flood damage may be reduced significantly by preventing inappropriate development from occurring in flood-prone areas. Local governments may accomplish floodplain management through their land use planning and zoning authority to protect the public health, safety, and welfare. Multi-objective management of flood-prone areas can provide significant benefits for recreation, water quality, and wildlife habitat while reducing the risk of future flood damage.

State statute allows cities and municipalities to designate flood zones and restrict the use of land within these zones. It requires that any local ordinances relating to flood zones be approved by the chief engineer of the Division of Water Resources before adoption and requires compliance with the Flood Insurance Act of 1968. Currently, out of 438 communities, 340 participate (78%) in the National Flood Insurance Program (NFIP) and six (1.4%) are current in the associated Community Rating System (CRS), according to the Kansas Water Plan.

According to the Kansas Water Plan (2009), the information indicates that there are 98 local jurisdictions that are known to be vulnerable to flood hazards that are not yet participants in the NFIP. According to the Kansas Water Plan, flood insurance is available to nearly 95% of Kansans living within identified flood hazard areas, but fewer than 15% of flood hazard area residents are actually covered by flood insurance (2005). Since the approval of the last plan, 10 communities joined the CRS (four have since been rescinded). Table 4.6 illustrates how the participation of Kansas communities in the NFIP changed between the 2004 and 2010 plans.

Table 4.6 Changes in National Flood Insurance Program Participation 2004–2010

Capability	2004	2010
NFIP Participation Total	327 communities	340 communities
NFIP Participation Suspended	12 communities	10 communities
Not in NFIP, Hazard Area Identified	101 communities	98 communities
CRS Participation	0 communities	10 communities *
Repetitive Loss Properties	343 properties	368 properties

Sources: Kansas Division of Emergency Management, Federal Emergency Management Agency
*Four communities have since been rescinded.

One concern of the state mitigation program is repetitive loss properties. As noted in Chapter 3, Table 3.35, there are 313 identified repetitive loss properties in Kansas. Flood losses to these properties have resulted in total payments of over $20 million over the last 30 years. To date, Kansas has used mitigation funding from various sources to mitigate 45 repetitive loss properties. There are six validated severe repetitive loss properties Total payments to these six properties and their contents have equaled $987,006.

Regional and Local Water Resource Management Organizations

Local governments are also authorized to develop storm water management and flood control projects and programs, provide local funding, and enter into agreements with other agencies to develop and use flood control works. State statutes also provide for the establishment of local drainage districts, water supply districts, and groundwater conservation districts.

Kansas state agencies are assisted in their efforts to effectively control water resources through regional and local water resource management organizations. From the state level, the Kansas Department of Health and Environment, State Conservation Commission, and the Kansas Water Office, work with these regional and local organizations on a regular basis. About 22% of the state is encompassed by organized watershed districts, which are formed primarily to cooperate on flood control efforts within a watershed. Watershed districts have taxing powers to support program implementation and cooperate on efforts to control erosion, sediment, and water supply within the watershed.

There are also conservation districts, rural water districts, public wholesale water supply districts, and drainage districts. The drainage districts are the former levee authorities who have a taxing authority. All of these local and regional water management organizations have a potential role in the future expansion and implementation of the Kansas Hazard Mitigation Plan.

National Weather Service StormReady Program

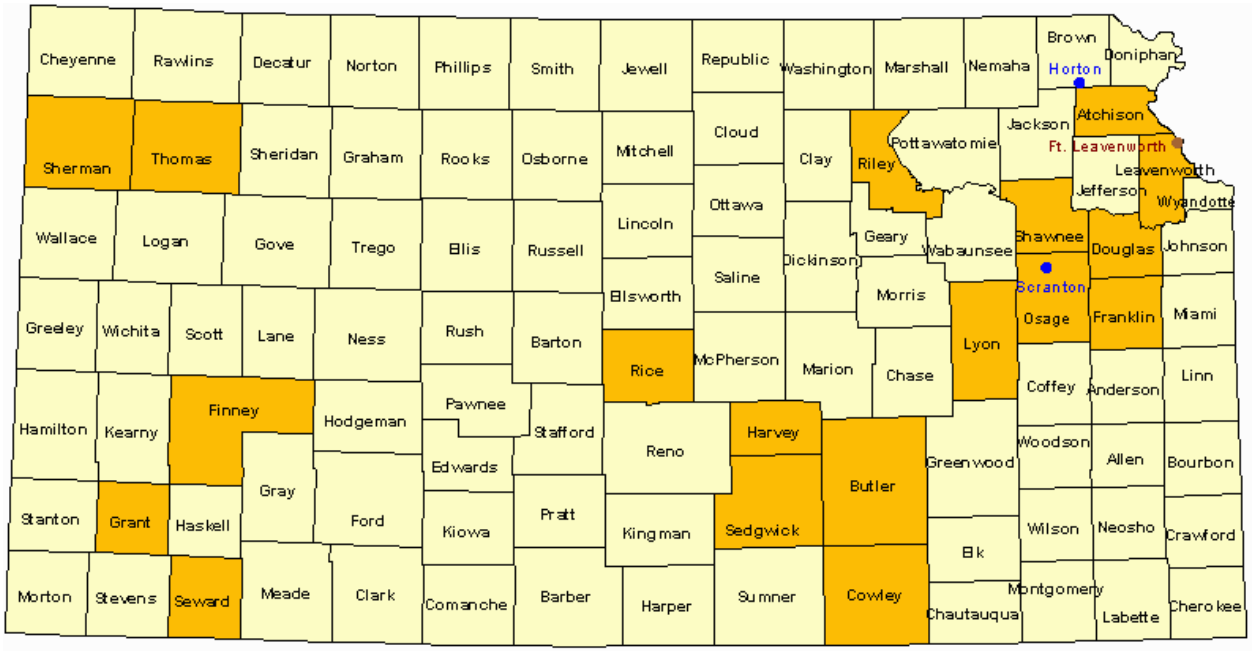
StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to flooding. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. StormReady is designed to help community leaders and emergency managers strengthen local safety programs.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than one way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars,
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

In Kansas, there are 18 counties, 2 communities, and 1 military site with StormReady designations (see Figure 4.3).

Figure 4.3 Kansas StormReady Communities



Source: National Weather Service StormReady Program, www.stormready.noaa.gov
Notes: Gold Shading: StormReady County, Blue Dot: StormReady Community, Brown Dot: StormReady Military

Geographic Information Systems

Technical capabilities, including GIS, vary greatly among Kansas counties. Capabilities in rural areas are very limited. GIS products and spatial analysis effectively allow communities to map where hazards exist and to combine areas of high risk with areas where many high value assets or vulnerable populations are found. The community can then visualize this information and target areas where mitigation activities would be beneficial.

The KHMT identified the problem of the lack of coordination between local GIS and emergency management staff along with the lack of data sharing and off site backup. As discussed in the state capability assessment, the Data Access and Support Center (DASC) have a program that allows local governments to back up GIS data at no cost. A collaborative web-based effort between the GIS Policy Board and DASC, The Kansas Geospatial Community Commons allows state and local governments to share information and promote services and products.

In addition, the Regional Homeland Security Councils, with the aid of various state agencies and The Kansas Collaborative, have established a GIS Leadership Team, which has partnered with DASC and the GIS Policy Board, to develop a statewide inventory of critical data layers at the local level. As a result, efforts are also underway to build a process for local verification and updates of statewide data layers. A Guidebook for County GIS Implementation has been completed and is available for downloading.

In 2007, The Kansas Collaborative conducted a GIS outreach workshop designed to raise awareness about uses of GIS in local government and to start the collaborative process. It was attended by representatives from 89 counties and 19 cities, which represents more than 90% of the target audience.

Limited mitigation capabilities in rural parts of the state, characterized by declining populations and high percentages of elderly and low-income residents, present challenges in improving local mitigation capabilities in Kansas. Regional planning and response and mutual aid agreements offer opportunities to combine resources and improve working relationships among counties and cities. Outreach and partnerships with local economic development entities, special districts, utilities, environmental organizations, the agricultural community, and schools offer opportunities to leverage different funding sources and meet multiple community objectives. Improved education and outreach at the local level can lead to greater household preparedness, public participation in, and support for mitigation policies and programs, as well as political support to address and fund mitigation needs.

Source: FEMA News Photo Kansas City, KS

4.4 Mitigation Actions

IFR REQUIREMENT *201.4(c)(3)(iii):*	[The State plans shall include an] identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.
Explanation:	Based on the risk assessment portion of the plan, the State **shall** include in its statewide mitigation strategy actions it has identified through its planning process as well as those actions identified in Local Plans. The State *should* describe what agencies and interested parties were involved in identifying priorities, how actions were evaluated, and how such actions correspond to the plan's mitigation goals and objectives. Mitigation actions *should* be directly tied to goals and objectives and provide the means to achieve them. Actions can be: Statewide or property specific. Regulatory or programmatic. Targeted at government agencies or private industry. Construction activities or public outreach.
IFR REQUIREMENT *Update §201.4(d):*	[The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities.

This section describes the intentions of the KHMT to address state and local vulnerabilities identified in the risk and capability assessments through specific mitigation actions that contribute to an overall mitigation strategy. Mitigation actions are specific activities that provide the detail on how the state will accomplish identified objectives, and ultimately meet the mission and goals outlined in this plan. This section also reports on the status of previously identified mitigation actions as a measure of the progress that Kansas is making toward its mitigation goals.

In 2004, the KHMT followed an approach prescribed by Mitigation 20/20 to identify mitigation ~~"i~~initiatives" and ~~"t~~asks" through a group process. The state is no longer using this software and methodology for the Kansas Hazard Mitigation Plan. The KHMT wanted to use a more streamlined process for the previous update to make the plan more effective and easier to use and to better track progress. In the 2010 update, the KHMT found the previous update approach was efficient and determined it would be best to use.

4.4.1 Identifying, Evaluating, and Prioritizing Mitigation Actions

The KHMT focused on identifying, evaluating, and prioritizing mitigation actions at their second plan update meeting in May 2010. The process for updating actions is described below.

2004 Actions—Completed, Deleted, and Deferred

The team began by evaluating the progress of existing actions developed for the 2004 and updated in the 2007 plan, which contained over 100 recommended tasks. Each agency reviewed the actions that it was responsible for in the previous plan and reported the status of these actions—completed, ongoing, uncompleted—and evaluated whether the action should be deleted from the plan or deferred and revised or incorporated into new actions in the updated plan. The evaluation criteria were:

- Completed: What aspects made the task effective or successful?
- Ongoing: Should the task be changed or revised?
- Not completed: Is the task still relevant and should it be included in the updated plan? If yes, how could it be improved?

Many initial tasks were completed as part of the previous plan update process, such as analyzing existing policy and regulatory framework and soliciting participation from other agencies. In general, items were deleted because some uncompleted tasks were not realistic to begin with or were deferred because of funding or staffing issues at state agencies. Many original tasks were individual steps in a larger action and have been incorporated into new or revised action items. Some previous tasks are ongoing and have been updated in new or revised actions that are more relevant to the current situation. Appendix M Mitigation Actions Completed or Deleted contains actions from the previous plan that were completed or deleted. If an action was deleted, the appendix explains why. This process was continued in the 2010 plan update. Most of the mitigation actions were made to be flexible in time and allowed action items to be on going through the life of the plan. This was the intent for the KHMT to allow mitigation items that could continue long term and not only address short-term goals.

In the 2004 plan, the Mitigation 20/20 approach outlined a process for review of progress on achieving goals. This process was not followed during the 2007 or 2010 update as the use of the software was discontinued by the state. The current approach is outlined in Chapter 6 Plan Maintenance Process. One of the measures to track progress is simply the number of mitigation actions that have been completed between in 2004 and 2007. The progress during that period indicates that over 70 tasks were completed and 22 are ongoing or revised into new actions. Over 80 tasks from the 2004 plan were deleted from the plan during the 2007 update. These trends demonstrate that the state is making progress toward meeting the goals of this plan. Many of the completed actions were easily implemented within existing state agency programs and budgets. Several of the deleted tasks were superseded by new actions, were not acted on because of funding or staffing, or were no longer considered relevant to the plan or a priority by the KHMT. How effective these actions are in reducing future losses remains to be seen, as this strategy is a continually evolving process. In the 2010 plan update there were four actions deleted and there were several actions that were combined after completion to continue the actions for further updates. There were also several actions that were deferred from the original and previously updated plans to be available when funding becomes obtainable in the state.

Linking Local Actions

Currently, within the State of Kansas, there are 36 approved Multi-Jurisdiction plans, one approved Single Jurisdiction plan and three approved school district plans. This shows a completion rate of approximately 35%. Additionally, 15 Multi-Jurisdiction plans are Approved Pending Adoption. Once these plans are fully approved, this should bring the completion rate to approximately 50% completion.

The contractor for the State Hazard Mitigation Plan update, Bold Planning Solutions, has developed a database for listing local plan action information in order to facilitate the link between the local plans and the state plan. This database will be maintained and updated by plans personnel within the Kansas Division of Emergency Management. Not only will this help to

link the plans together, but will also satisfy the action listed, which states, –Develop local mitigation actions database based on local plans to easily identify and track potential projects."

Identifying New Mitigation Actions

The KHMT discussed the mitigation actions in a round table format during the second meeting for the 2010 plan update. Based on the updated risk and capability assessments, the KHMT reviewed a risk assessment summary prepared to assist them in identifying mitigation measures. The KHMT used information, such as, the average number of events per year and the average annual losses in terms of deaths, injuries, and property damage. The group learned facts such as: hail happens more often than any other event however, it causes fewer property losses, deaths, and injuries than tornadoes and floods. This type of information helped the team make difficult prioritization decisions.

The KHMT also reviewed a summary of the themes identified in a small group process to assess state and local mitigation capabilities, which was described in Section 4.2.5. This activity highlighted the obstacles, and opportunities, to strengthening the state's mitigation capabilities.

Evaluating and Prioritizing Mitigation Actions

As a result of the activities discussed above, the KHMT identified a number of new or revised actions that needed to be evaluated and prioritized. The team followed the FEMA-recommended approach of examining available alternatives and then applying criteria to those alternatives to determine their priority.

To evaluate alternative mitigation actions, the KHMT reviewed a list of mitigation actions that are applicable to reducing future losses for multiple hazards and mitigation action categories developed and promoted by the Community Rating System (CRS):

- Prevention
- Emergency Services
- Property Protection
- Natural Resources Protection
- Structural Projects
- Public Information

The KHMT reviewed multiple mitigation actions for different hazards under each of the CRS categories. The team also discussed the value of actions that address multiple hazards simultaneously and that achieve multiple objectives.

The KHMT used the STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) framework as the criteria for prioritizing actions. They also prioritized actions based on how well they addressed the plan's updated goals and objectives.

Using the criteria for prioritization, each agency in the KHMT identified their highest priority actions that remained from the previous plan. These high priority actions were defined by identifying the proposed actions, old and new, that best represented the most important activities that their agency should undertake now to reduce future disaster losses.

The KHMT chose to only evaluate high priority actions. It was decided that the 2004 plan had so many recommended actions that many were lost in the sheer quantity and that the 2007 plan should make a concerted effort to identify fewer, more meaningful actions. This would result in greater focus on the implementation of the high priority actions. By identifying only high priority actions, the KHMT agreed that the remaining recommendations would be assigned lower priorities. The KHMT found that the previous update process was an acceptable measure to implement mitigation items. The 2010 approach followed the same format as the previous update. The KHMT e-mailed the current mitigation items to committee members to place an ~~"X"~~ by the ten mitigation items that they felt best served the meaning of the hazard mitigation efforts. These were then calculated to get an overall ~~"T~~op Ten" mitigation item list that would be ranked as ~~"h~~igh" priority for the KHMT (on file at KDEM). The other mitigation items were then determined to be ~~"m~~edium" and the ones that have had no actions were labeled ~~"d~~eferred" and placed at the bottom of the mitigation item list. However, the items labeled ~~"d~~eferred" can become active if situations should change to allow them to be acted upon, such as, an economic turnaround and funds become available to activate the mitigation items.

The handouts used to identify, evaluate, and prioritize mitigation actions are included in a planning reference notebook on file with KDEM and include the following: Summary of Progress on 2007 Mitigation Tasks, 2007 Mitigation Task List, and Mitigation Criteria List.

4.4.2 2010 Updated Mitigation Actions

The Mitigation Action Strategy Summary in Table 4.7 is the result of the process to identify, evaluate, and prioritize updated mitigation actions. It includes a brief description of the action item and its priority, lead agency, and contribution to the overall mitigation strategy. The Objective ID column ties the actions to the strategy by noting the primary corresponding goal and objective. Where actions meet multiple goals and objectives these are indicated. Mitigation action implementation worksheets were completed for each action by the responsible agencies. These worksheets include information on the background of each action, alternatives considered, responsible agency, supporting agencies, priority, benefits, cost estimate, potential funding source, and schedule. The worksheets were used to populate a master spreadsheet documenting the mitigation actions in more detail. Additional action details are compiled in Appendix N Mitigation Action Details. Actions from the previous update that were completed or deleted are listed in Appendix M Mitigation Actions Completed or Deleted.

Table 4.7 Mitigation Action Strategy Summary

Action Title	Lead Agency*	Support Agencies*	Priority	Status	Status Report	Objective ID**
1. Promote tornado safe rooms in public facilities	KDEM	KDOC, local emergency management offices	High	On-Going	Safe Rooms are the top priority of HMGP grant funding within the State of Kansas	**1.1**
2. Mitigate repetitive flood loss and severe repetitive flood loss structures	DWR	KDEM	High	On-Going		1.3
3. Complete local mitigation plans	KDEM	Kansas Legislature	High	On-Going	Mitigation plans are approximately 38% complete.	2.1
4. Provide automatic weather stations	KWO	KSU (state climatologist), NWS, KDOT, USGS	High	On-Going		1.1
5. Develop inundation maps for high hazard dams	KDA	SCC, KDEM, KWO, dam owners	High	On-Going		1.1
6. Enforce and assist with development of emergency action plans for high and significant hazard dams	KDA	SCC, KDEM, KWO, dam owners	High	On-Going		1.1
7. Increase support for and participation in the National Flood Insurance Program (NFIP) and Community Rating System (CRS)	DWR	KWO, KDEM	High	On-Going	In 2010, three communities filed new CRS applications to participate (Shawnee County, Leavenworth, and Lenexa)	1.3, 2.2, 1.6
8. Continue support for floodplain mapping studies	DWR	KWO	High	On-Going	This is an ongoing activity. See Figure 4.1.	1.3
9. Promote hazard mitigation and emergency management training for special needs populations	KDHE	SRS, KDEM, Governor's Office, TAG, KDOAg, KDOE	High	On-Going		4.1
10. Rehabilitate and repair identified deficient dams	KDA	SCC, KDEM, KWO, dam owners	High	On-Going		1.2
11. Conduct a pilot wildfire vulnerability study	KFS	KSFMO	High	On-Going	Started in 2008.	3.5
12. Improve coordination between the Kansas Water Plan and the Kansas Hazard Mitigation Plan	KWO	DWR, KDHE, KSU, SCC, KDEM	High	On-Going		3.1
13. Identify priority flood issues in river basin sections of revised Kansas Water Plan	KWO	KDEM	High	On-Going	GIS Department will complete HAZUS training to perform HAZUS analysis reports on river flood plain vulnerability analysis projections.	3.1

Action Title	Lead Agency*	Support Agencies*	Priority	Status	Status Report	Objective ID**
14. Document statewide participation in National Flood Insurance Program and Community Rating System	KDA	KDEM	Medium	On-Going	This is tracked on an annual basis. The State of Kansas will continue to support NFIP participation	2.2
15. Enhance the system for tracking buyouts to incorporate mitigation projects for all hazards	KDEM	KDOC	Medium	Ongoing from 2004	KDEM Mitigation uses the NEMIS program, spreadsheets and GIS layers to track mitigation projects.	3.5
16. Update and implement the HMGP administrative plan	KDEM	FEMA	Medium	On-Going	The HMGP Admin Plan is FEMA Approved up to the current disaster (1885)	2.4
17. Develop local mitigation actions database based on local plans to easily identify and track potential projects	KDEM	KITO	Medium	On-Going	The state's hazard mitigation plan contractor, Bold Planning Solutions, has designed an operational database, which will be updated by the state.	3.4
18. Compile materials regarding existing, example local codes and ordinances addressing flood hazards and floodplain management	KDA	KWO	Medium	On-Going		1.3
19. Develop a system for emergency event and disaster loss tracking	KDEM	KDHE	Medium	On-Going	2010 Enhance past event data for expansive soils and drought occurrences across the State of Kansas. Drought events will be compared to NCDC results to verify consistency. Expansive soil events will be recorded even if property or crop damage is not realized (as applicable)	3.5
20. Promote the Firewise/Community Wildfire Protection Plan (CWPP)/Fire Master Plan program	KFS	KSFMO	Medium	On-Going	Kansas has one Firewise community. The state has a template for CWPPs and fire master plans for counties to use in developing their plans.	1.3
21. Conduct outreach activities to Kansas Emergency Management Association	KDEM	TAG	Medium	On-Going	KDEM makes an annual presentation to KEMA.	4.1
22. Improve coordination among state level post-disaster mitigation and recovery efforts	KDEM	KDHE, DWR, rural electric cooperatives, local jurisdictions	Medium	On-Going		**3.1**
23. Coordinate GIS capability improvements for emergency management with the Kansas Statewide GIS Strategic Plan	TAG	All State agencies with GIS Capability	Medium	On-Going	Currently, in 2010, the Adjutant General's GIS Department has interns mapping County Facilities. State facilities will follow within the next three years. This will give us actual numbers, where facilities are located in hazardous areas, as well as the ability to map all critical facilities, state, county and local. Facilities will also be cross-referenced	**3.1**

Action Title	Lead Agency*	Support Agencies*	Priority	Status	Status Report	Objective ID**
					to insurance database which will include structure and content values for accurate loss estimate calculations. Next mitigation plan update will include this information.	
24. Acquire new state-wide elevation data (two-foot contours)	KDA	KDEM	Medium	On-Going		3.5
25. Develop a system for mitigation success story tracking and documentation	KDEM	KDOC	Medium	On-Going	KDEM website update should be completed in 2010.	3.4
26. Conduct tornado safety training	KDEM	Local Emergency Management	Medium	On-Going	Training programs occur annually.	4.3
27. Provide education and training on mitigation actions and funding possibilities for cultural properties	KDEM	KSHS	Medium	On-Going	No action taken since 2007	4.1 2.5
28. Refine risk/vulnerability assessment in regard to public health and improve coordination on state vulnerability assessments	KDEM	KDHE	Medium	On-Going	No action has been taken since 2007	**3.1, 3.5**
29. Continue continuity of operations (COOP) planning throughout all interested agencies in state government.	KDEM	TAG	Medium	On-Going	COOP/COG was initiated on December 8, 2008 with a Governor's Proclamation. www.coopkansas.com COOP planning tools have been deployed across the State of Kansas.	**3.1**
30. Conduct all hazards exercises	KDEM	All State Agencies	Medium	On-Going		**4.1**
31. Improve KDEM's website with respect to mitigation	KDEM	DISC, KITO	Medium	On-Going	The new KDEM website update began at the end of 2009 and should be completed in 2010.	2.4
32. Adopt and fund a state grant program for funding of safe rooms in new and existing schools throughout the state	KDEM	KDOE	Medium	Deferred from 2004	Deferred until potential funding can be established.	1.5, 2.5
33. Propose legislation for statewide adoption to require local governments to include safe rooms upon building a	KDEM	KDOE	Medium	Deferred from 2004	Deferred until potential funding can be established	1.5

Action Title	Lead Agency*	Support Agencies*	Priority	Status	Status Report	Objective ID**
new school or building new construction at an existing school						
34. Identify top 50 private employers in state with safety and health problems, then provide contractor services and education to mitigate	KDOL	KDEM	Medium	On-Going		4.1
35. Develop standardized hazard probability methodology for local planners	KDEM	TAG	Medium	New 2010	Standardized hazard probability template has been created by the mitigation planning team. It will be disseminated out to local planners in 2011. This template will establish common hazard probability methodology that can be compared at a regional level across the State of Kansas.	3.6

Actions Removed and/or Combined With Other On-Going Actions
Develop a Continuity of Operations Plan for Docking Building
Develop a Continuity of Operations Plan for Landon Building
Develop a Continuity of Operations Plan for State House
Completed or Combined With Other On-Going Actions
Integrate flood mitigation into KDOT construction projects
Create a model ordinance for local jurisdictions interested in regulating dam breach inundation areas (completed and removed)
Conduct a flood hazard vulnerability study as a part of the pilot multi-hazard vulnerability assessment to develop an acceptable approach to vulnerability assessments in Kansas
Focus National Flood Insurance Program (NFIP) and Community Rating System (CRS) outreach efforts to priority areas

*Agencies:
DISC—Division of Information Systems and Communications
DWR—Division of Water Resources
KDA—Kansas Department of Agriculture
KDEM—Kansas Division of Emergency Management
KDHE—Kansas Department of Health and Environment
KDOA—Kansas Department of Administration
KDOAg—Kansas Department of Aging
KDOC—Kansas Department of Commerce
KDOE—Kansas State Department of Education
KDOL—Kansas Department of Labor
KDOT—Kansas Department of Transportation
KFS—Kansas Forest Service
KHP—Kansas Highway Patrol
KITO—Kansas Information Technology Office
KSFMO—Kansas State Fire Marshal's Office
KSHS—Kansas State Historical Society
KSU—Kansas State University
KWO—Kansas Water Office
SCC—State Conservation Commission
SRS—Kansas Department of Social and Rehabilitation Services
TAG—Adjutant General's Department

**Corresponds to goals and objectives listed at the beginning of Chapter 4. For reference, the goals are listed here:
Goal 1: Minimize the vulnerability of the people, property, environment, and economy of Kansas and its communities to the impacts of natural and manmade hazards
Goal 2: Build the mitigation capabilities of local governments throughout Kansas in establishing and implementing effective mitigation plans, policies, and programs
Goal 3: Promote a state policy framework for effective hazard mitigation programming in the state
Goal 4: Improve education and training in hazard mitigation and related programs for government officials, business, and the public

4.5 Funding Sources

IFR REQUIREMENT 201.4©(3)(iv):	[The State mitigation strategy shall include an] identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.
Explanation:	The plan **shall** describe the current funding sources as well as potential sources that will be pursued to fund proposed mitigation projects and actions. It *should* also identify where funding is required to implement a project/activity identified in the mitigation strategy. Funding alternatives **shall** include Federal, State, local, and private sources. The description can also include novel or alternative ways to fund actions, such as: Combining funding from various programs to implement a mitigation project. Integrating mitigation actions in implementing agencies‘ work plans. Identifying mitigation opportunities that may arise during scheduled infrastructure improvements, maintenance, or replacement, or other capital improvements. Building partnerships with businesses and non-profits whose properties, employees, or clients may be affected by hazards. Combining funding from various Federal programs to fund a comprehensive plan with a mitigation component.

There is a wide variety of mitigation funding opportunities. Currently, the majority of the funding used by Kansas for mitigation activities comes from the federal government. This section discusses the primary sources for mitigation funding, both current and potential.

4.5.1 Federal Funding Sources

Since the last update of the Kansas Hazard Mitigation Plan, the state‘s primary federal source of hazard mitigation funding has been FEMA‘s Hazard Mitigation Grant Program. More detail on how this assistance was used since 2007 can be found on the following pages. Other important FEMA hazard mitigation programs, which the state intends to pursue in the future include the Pre-Disaster Mitigation program, Flood Mitigation Assistance Program, Repetitive Flood Claims program, and Severe Repetitive Loss program. All five of these FEMA programs are discussed further in this section.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a FEMA program. Its purpose is to provide funds to states, territories, Indian tribal governments, and communities to significantly reduce or permanently eliminate future risk to lives and property from natural hazards. HMGP funds projects in accordance with priorities identified in state, tribal, or local hazard mitigation plans, and enables mitigation measures to be implemented during the recovery from a disaster.

HMGP funds can be used for projects to protect either public or private property, as long as the project fits within state and local government mitigation strategies to address areas of risk and complies with program guidelines. Examples of projects include acquiring and relocating structures from hazard-prone areas; retrofitting structures to protect them from floods, high winds, earthquakes, or other natural hazards; constructing certain types of minor and localized flood control projects; and constructing safe rooms inside schools or other buildings in tornado-prone areas.

The state may set aside up to seven percent of the HMGP funds received following a presidential disaster declaration to develop FEMA-approved mitigation plans. The state may also set aside up to five percent of the HMGP funds to be used to fund 5% Set-Aside Projects.

Amount: Federal funding under the HMGP is available following a major disaster declaration if requested by the governor. The amount of an HMGP grant will depend on the costs associated with each individual disaster. Since the Kansas Hazard Mitigation Plan is a standard hazard mitigation plan, Kansas is eligible for 15% for amounts not more than $2 billion, 10% for amounts of more than $2 billion and not more than $10 billion, and 7.5% on amounts more than $10 billion and not more than $35.3 billion.

Eligibility: HMGP funds are administered by KDEM. Local governments, certain private nonprofit organizations or institutions, and Indian tribes or authorized tribal organizations are eligible to apply to KDEM for assistance as subapplicants. Individuals and businesses are not eligible to apply to the state, but eligible local governments or private nonprofit organizations may apply on their behalf. KDEM reviews and prioritizes subapplications and submits the grant application with subapplications to FEMA for review and approval.

For project grants, subapplicants must have a FEMA-approved local mitigation plan. All activities submitted for consideration must be consistent with the local mitigation plan as well as the Kansas Hazard Mitigation Plan.

Cost-Share Requirements: HMGP funds are provided on a 75% federal to 25% nonfederal cost share basis. The nonfederal match does not does not need to be cash; in-kind services and/or materials may be used.

More Information: www.fema.gov/government/grant/hmgp/index.shtm

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) program is a FEMA grant program. Its purpose is to provide funds to states, territories, Indian tribal governments, and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations.

Project grants are available for voluntary acquisition of real property (i.e., structures and land, where necessary) for open space conversion; relocation of public or private structures; elevation of existing public or private structures to avoid flooding; structural and nonstructural retrofitting of existing public or private structures to meet/exceed applicable building codes; construction of safe rooms for public and private structures; vegetation management (e.g., for wildfire); protective measures for utilities, water and sanitary sewer systems, and infrastructure; storm water management projects; and localized flood control projects, which are designed specifically to protect critical facilities and that do not constitute a section of a larger flood control system.

Planning grants are available for new plan development, plan upgrades, and comprehensive plan reviews and updates.

Amount: In another major development in FY2008, Congress directed 95 grants to 28 states, which totaled close to 44% of all PDM funds (P.L. 110-161, Consolidated Appropriations Act, 2008). These were the first such earmarks for the PDM program. While some of the projects meet PDM eligibility standards, others may be considered emergency preparedness projects, which are not eligible for grants, as defined by the Stafford Act and the PDM guidance. For FY2009, Congress directed 51 grants to 27 states at a program cost of just under $25 million. The FY2010 DHS appropriations measure currently has a funding level of $100 million proposed with just less than $25 million for congressionally directed projects. The listing of directed grants for the last two fiscal years provides information on jurisdictions but does not have details on the types of projects involved. In consideration of the FY2010 appropriations, amendments were offered in the House and Senate to curtail the earmarking of PDM funds.

Eligibility: In Kansas, KDEM serves as the applicant for all PDM grants. State-level agencies, including state institutions (e.g., state hospital or university); federally recognized Indian tribal governments; local governments (including state recognized Indian tribes and authorized Indian tribal organizations); public colleges and universities; and Indian Tribal colleges and universities are eligible to apply to KDEM for assistance as subapplicants. Private nonprofit organizations and private colleges and universities are not eligible to apply to the state, but an eligible, relevant state agency or local government may apply on their behalf. KDEM reviews and prioritizes subapplications and submits the grant application with subapplications to FEMA for review and approval.

All sub applicants that have been identified through the NFIP as having a Special Flood Hazard Area and that have a Flood Hazard Boundary Map or a Flood Insurance Rate Map must be participating and in good standing in the NFIP.

For project grants, subapplicants must have a FEMA-approved local mitigation plan. All activities submitted for consideration must be consistent with the local mitigation plan as well as the Kansas Hazard Mitigation Plan.

Cost-Share Requirements: PDM grants are provided on a 75%t federal/25% nonfederal cost share basis. Small and impoverished communities may be eligible for up to a 90% federal cost-share.

Requirements: Recipients of PDM planning grants must produce FEMA-approved hazard mitigation plans.

More Information: www.fema.gov/government/grant/pdm/index.shtm

Flood Mitigation Assistance Program

The Flood Mitigation Assistance Program (FMA) is a program under FEMA's National Flood Insurance Program (NFIP). Its purpose is to implement cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). The FMA provides planning grants for communities to assess their flood risk and identify actions to reduce it.

Planning grants may be used to develop a new or update an existing flood mitigation plan (this also applies to the flood hazard portion of multihazard mitigation plans).

Project grants are available for acquisition, structure demolition, or structure relocation with the property deed restricted for open space uses in perpetuity; elevation of structures; dry floodproofing of nonresidential structures; and minor structural flood control activities. Planning grants are available for flood mitigation planning activities.

Amount: For fiscal year 2009 (December 2008–November 2009), Congress appropriated $35.7 million for the FMA. Based on an allocation formula, each state will receive a base amount of $110,000. Surplus amounts will be distributed based on each state/territory‘s participation in the NFIP (number of policies and repetitive loss properties).

The total amount of FMA grant funds provided during any 5-year period will not exceed $10,000,000 to any state agencies or $3,300,000 to any community. The total amount of FMA grant funds provided to any state, including all communities located in the state will not exceed $20,000,000 during any 5-year period. The administrator may waive the limits of this subsection for any 5-year period when a major disaster or emergency is declared pursuant to the Robert T. Stafford Disaster Relief and Emergency Assistance Act for flood conditions.

Eligibility: In Kansas, KDEM serves as the applicant for all FMA grants. State-level agencies, federally recognized Indian tribal governments, and local governments (including state-recognized Indian tribes and authorized Indian tribal organizations) are eligible to apply to KDEM for assistance as subapplicants. Individuals and private nonprofit organizations are not eligible to apply to the state, but a relevant state agency or local community may apply on their behalf. KDEM reviews and prioritizes subapplications and submits the grant application with subapplications to FEMA for review and approval.

All subapplicants must be participating and in good standing in the NFIP. For project grants, subapplicants must have a FEMA-approved flood mitigation plan or multi-hazard mitigation plan that meets FMA planning requirements. All activities submitted for consideration must be consistent with the local mitigation plan as well as the Kansas Hazard Mitigation Plan.

Cost-Share Requirements: FMA funds are provided on a 75% federal/25% nonfederal cost share basis. The recipient must provide the 25% match, only half of which may be in-kind contributions. For severe repetitive loss properties, FEMA will contribute up to 90% of the total eligible costs if the state has taken actions to reduce the number of severe repetitive loss properties and has an approved state mitigation plan that specifies how it intends to reduce the number of severe repetitive loss properties.

Requirements: Recipients of FMA planning grants must produce FEMA-approved flood mitigation plans.

More Information: www.fema.gov/government/grant/fma/index.shtm

Repetitive Flood Claims Program

The Repetitive Flood Claims (RFC) program is a FEMA program. Its purpose is to reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP) that have had one or more claim payment(s) for flood damage.

Project grants are available for acquisition, structure demolition, or structure relocation with the property deed restricted for open-space uses in perpetuity. Planning grants are not available.

Amount: For fiscal year 2009 (June 19, 2008-December 19, 2008), Congress appropriated $10 million for the RFC program. RFC grants are awarded nationally without reference to state allocations, quotas, or other formula-based allocation(s) of funds.

Eligibility: RFC funds can only be used to mitigate structures that are located within a state or community that cannot meet the requirements of the FMA for either cost share or capacity to manage the activities.

In Kansas, KDEM serves as the applicant for all RFC grants. State-level agencies, federally recognized Indian tribal governments, and local governments (including state-recognized Indian tribes and authorized Indian tribal organizations) are eligible to apply to KDEM for assistance as subapplicants. Individuals and private nonprofit organizations are not eligible to apply to the state, but a relevant state agency or local community may apply on their behalf. KDEM reviews and prioritizes subapplications and submits the grant application with subapplications to FEMA for review and approval.

All subapplicants must be participating and in good standing in the NFIP.

Cost-Share Requirements: All RFC grants are eligible for up to 100% federal assistance.

More Information: www.fema.gov/government/grant/rfc/index.shtm

Severe Repetitive Loss Program

The Severe Repetitive Loss (SRL) program is a FEMA program. Its purpose is to reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential properties and the associated drain on the National Flood Insurance Fund (NFIF) from such properties. FEMA defines SRL properties as residential properties that have at least four NFIP claim payments over $5,000 each, at least two of which occurred within any ten-year period, and the cumulative amount of such claims payments exceeds $20,000; or that have at least two separate claims payments (building payments only) where the total of the payments exceeds the value of the property, when two such claims have occurred within any ten-year period.

Project grants are available for flood mitigation activities such as acquisition, structure demolition, or structure relocation with the property deed restricted for open-space uses in perpetuity; elevation of structures; floodproofing of structures; minor physical localized flood control projects; and demolition and rebuilding of structures. Planning grants are not available.

Amount: The SRL program is authorized for up to $40 million for each fiscal year 2005 through 2009.

Eligibility: In Kansas, KDEM serves as the applicant for all SRL grants. State-level agencies, federally recognized Indian tribal governments, and local governments (including state-recognized Indian tribes and authorized Indian tribal organizations) are eligible to apply to KDEM for assistance as subapplicants. Individuals and private nonprofit organizations are not eligible to apply to the state, but a relevant state agency or local community may apply on their behalf. KDEM reviews and prioritizes subapplications and submits the grant application with subapplications to FEMA for review and approval.

All subapplicants must be participating and in good standing in the NFIP.

Cost-Share Requirements: SRL grants are provided on a 75% federal/25% nonfederal cost share basis. Up to 90% federal cost-share funding may be available for projects approved in states, territories, and federally recognized Indian Tribes with FEMA-approved standard or enhanced mitigation plans or Indian tribal plans that include a strategy for mitigating existing and future SRL properties.

More Information: www.fema.gov/government/grant/srl/index.shtm

Hazard Mitigation Funding Under Section 406 (Stafford Act)

The Robert T. Stafford Disaster Relief and Emergency Assistance Act provides FEMA the authority to fund the restoration of eligible facilities that have sustained damage because of a presidentially declared disaster. Title 44 CFR §206.226 Restoration of Damaged Facilities contains a provision for the consideration of funding additional measures that will enhance a facility's ability to resist similar damage in future events.

In providing discretionary authority for the addition of hazard mitigation measures to permanent work restoration, Congress recognized that during the repair of damaged components of facilities there would be a unique opportunity to prevent recurrence of similar damage from future, similar disaster events. Such measures are in addition to any measures undertaken to comply with applicable codes and standards, although such compliance, itself, could be considered a form of mitigation.

Section 406 hazard mitigation funding and Section 404 hazard mitigation funding are distinct. Section 406 is applied on the parts of the facility that were actually damaged by the disaster and the mitigation measure provides protection from subsequent events. The mitigation work must be cost effective and be reasonably performed as part of the work or measure that will reduce the potential for damage to a facility from a disaster event. Sometimes, a combination of Section 406 and 404 funding may be appropriate, where Section 406 hazard mitigation funding is used to provide protection to the parts of the facility that were damaged and Section 404 hazard mitigation funding is used to provide protection to the undamaged parts of the facility. In these instances, the application for Section 404 hazard mitigation funding must be submitted in a timely manner, consistent with state and local hazard mitigation plans, and approved by the State Hazard Mitigation Officer.

1. FEMA may provide discretionary hazard mitigation funding under Section 406 of the Stafford Act. FEMA, grantee and sub grantee‘s interests in disaster resistance must be balanced with the supplemental nature of disaster assistance and FEMA's obligation for the prudent stewardship of federal disaster funds.

2. Only FEMA is authorized to interpret and implement the Stafford Act and regulations issued pursuant to the Stafford Act. Accordingly, only FEMA has the authority to determine which hazard mitigation measures it will fund. The Stafford Act and applicable regulations do not authorize state or local building officials or agencies to determine the amount of hazard mitigation funding FEMA will contribute to a project

Amount: Contact the Disaster Assistance Directorat (Public Assistance Division for current Section 406 Funding availability.

Eligibility: Section 406 provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities. These opportunities usually present themselves during the repair efforts. The mitigation measures must be related to eligible disaster-related damages and must directly reduce the potential of future, similar disaster damages to the eligible facility. Normally, this work is performed on the parts of the facility that were actually damaged by the disaster. In some instances, an eligible mitigation measure may not be an integral part of the damaged facility. FEMA will consider these exceptions on a case-by-case basis.

Cost-Share Requirements: Contact the Disaster Assistance Directorat (Public Assistance Division for current cost share requirements.

Requirements:

A. Mitigation measures must be determined to be cost effective. Any one of the following means may be used to determine cost-effectiveness:

1. Mitigation measures may amount to up to 15% of the total eligible cost of the eligible repair work on a particular project.

2. Certain mitigation measures (see Appendix A) may be determined cost effective, as long as the mitigation measure does not exceed 100% of the eligible cost of the eligible repair work on the project.

3. For measures that exceed the above costs, the grantee or sub grantee must demonstrate through an acceptable benefit/cost analysis methodology that the measure is cost effective. FEMA's Benefit Cost Analysis (BCA) software provides appropriate benefit/cost analysis methodologies. Public assistance personnel can obtain the software from FEMA by downloading the software from http://www.bchelpline.com. If

you need technical assistance with the FEMA BCA tools please contact the BCA helpline via e-mail (bchelpline@dhs.gov) or by calling 1-866-222-3580. The benefit/cost analysis will be based on a comparison of the total project cost to the total cost of the following projected benefits: 1) damage to the facility and its damaged contents, 2) emergency protective measures required as a result of that damage, 3) temporary facilities required due to the damage, 4) loss of function, 5) casualty (loss of life and injury), and 6) cost avoidance (damages avoided in the future because of mitigation measures).

B. If a facility has Section 406 hazard mitigation funding included in the approved scope of work (SOW) and the subgrantee wishes to restore the facility to its pre-disaster condition and function without the Section 406 hazard mitigation SOW, then the subgrantee must request a change of SOW prior to completion of the project. Section 406 hazard mitigation funds must be de-obligated when the subgrantee does not use the funds as approved in the SOW.

C. FEMA must approve proposed hazard mitigation projects prior to funding. FEMA will evaluate the proposed hazard mitigation projects for cost effectiveness, technical feasibility, and compliance with statutory, and regulatory and executive order requirements. In addition, FEMA will ensure that the proposed hazard mitigation projects do not cause a negative impact to the facility's operation, surrounding areas, or susceptibility to damage from another hazard.

D. The cost of meeting applicable codes/standards in accordance with 44 CFR §206.226(d) Restoration of damaged facilities, Standards and minimum National Flood Insurance Program requirements are regulatory requirements that are distinct from hazard mitigation. Funding for these costs is considered separately.

E. When the cost of proposed replacement material for a damaged component is more than the original material, the proposed material must be shown to be cost effective.

F. There may be no duplication in hazard mitigation funding between Sections 404 and 406. Therefore, the grantee and sub grantee must be able to identify specific hazard mitigation work that will be accomplished with funding through Section 406. Section 404 funding may not duplicate that work, although Section 404 may be added and accomplished on Section 406 facilities. The appropriate split on a project between funds under Sections 404 and 406 is a FEMA decision. Sections 404 and 406 funding cannot be used to meet the non-federal cost share of the other grant.

G. Funds recommended for mitigation measures may be approved for an improved project if the original facility and its function will be restored and the mitigation work is still needed, is technically feasible, and will be performed as part of the overall project. Facilities eligible for replacement under 44 CFR 206.226(f)

Restoration of damaged facilities. Repair vs. replacement are not eligible for mitigation measures.

1. If mitigation measures are approved for the repair of a disaster-damaged facility and the subgrantee requests an improved project, which will instead involve the replacement of the facility, on the same site or an alternate site, the cost of the mitigation measures is not eligible.

2. The cost of mitigation measures approved under Section 406 for the repair of a facility may not be applied toward an Alternate Project

More Information: www.fema.gov/government/grant/pa/9526_1.shtm

Other Potential Sources of Federal Funding and Technical Assistance

Additional sources of federal funding and technical assistance, including programs of other federal agencies, such as the U.S. Army Corps of Engineers, U.S. Department of Agriculture, U.S. Department of Housing and Urban Development, U.S. Department of the Interior, U.S. Department of Health and Human Services, U.S. Environmental Protection Agency, and others, can be found in Appendix B Federal Assistance Programs.

4.5.2 State Funding Sources

For information about state funding sources, see Section 4.2.3 State Funding Capabilities and Section 4.5.3 Local Funding Sources below.

4.5.3 Local Funding Sources

Most local governments in Kansas do not have a dedicated funding source for mitigation activities and rely on grant programs to implement actions and projects. Some communities are able to implement mitigation-related projects through their public works and capital improvements budgets. Local match requirements for mitigation planning and project grants are most often met through ~~s~~oft" match, or in-kind services.

4.5.4 Private Funding Sources

The State of Kansas does not typically use private funding sources to implement mitigation actions. Public-private partnerships are encouraged at the local level as a method of leveraging funding for local mitigation projects. In the past, some donations have been used for storm shelters and weather transmitters; however there have been no major donors for this program.

4.5.5 Funding for Mitigation Actions 2004 to 2010

Kansas received eight presidential major disaster declarations between January 2008 and April 2010. HMGP funding received as a result of these declarations is detailed by disaster declaration later in this section. In some cases, not all available funds were spent. This is due to the low number of eligible applicants with FEMA-approved local mitigation plans during this time period. This underscores the importance of having local plans and should improve over time as the state provides financial and technical assistance for the development of these plans as outlined in Chapter 5 Coordination of Local Mitigation Planning.

FEMA-1535-DR Severe Storms, Flooding, and Tornadoes (June 2004) Mitigation Funding: $864,129 (Project‘s closed)

Tornado Safe Rooms in Schools—Over 375 students and faculty were provided safe shelter during severe storms at the Holy Cross School in Hutchinson ($118, 000).

Acquisition/Demolition - Five repetitive flood loss properties were removed from the floodplain in Kansas City ($228,000).

Bridge Protection—Bend way weir project was funded to protect a $2 million bridge over the Neosho River ($429,000).

FEMA-1562-DR Severe Storms, Flooding, and Tornadoes (August 2004) Mitigation Funding: $127,800 (Project‘s closed).

Tornado Safe Rooms in Schools—Over 400 students and faculty in Wichita were provided safe shelter during severe storms ($101,000).

FEMA-1579-DR Severe Winter Storm, Heavy Rains, and Flooding (January 2005) Mitigation Funding: $5,661,699 (Pending closeout).

Tornado Safe Rooms—Over 5,800 students and faculty in Haysville (five schools), Andover (four schools and one library), Maize (one school), and Wichita (one school) provided safe shelter during severe storms ($2.7 million).

FEMA-1600-DR Severe Storms and Flooding (August 2005) Mitigation Funding: $251,845 estimated (Pending closeout).

Tornado Safe Rooms in Schools—Over 800 students and faculty were provided safe shelter in Wichita during severe storms ($178,200).

FEMA-1626-DR Severe Winter Storm (January 2006) Mitigation Funding: $2,403,374 estimated (Completed but not closed out).

1 acquisition/demolition project ($330,790).

1 tornado shelter in library ($212,644).

FEMA-1638-DR Severe Storms, Tornadoes, and Straight-Line Winds (April 2006). Mitigation Funding: $311,005 estimated (Project in final stage)

1 shelter in school ($247,000).

DR-1675 – Ice Storm, December 2006. Mitigation Funding – $41,025,918 (Working all projects)

- Mitigation Plans funding for all counties that applied in the state.
- Purchase and Demolition of 11 Properties in Allen County.
- Storm Shelter in Bonner Springs Fire Department.
- Power Line Retro-fitting projects for Butler Co Rural Electric Cooperative (REC), Flinthills REC, Heartland REC, Twin Valley REC, and Wichita REC.
- Purchase and Demolition of 8 Properties in Chanute, KS.
- Purchase and Demolition of 21 properties in Cherokee County.
- Acquisition and Demolition of 6 properties in Coffeyville, KS.
- Dam Breach Inundation Map Study for the Dept. of Agriculture.
- Purchase and Demolition of 11 properties in Erie, KS.
- Tornado Safe Rooms – Erie USD 101, Family Life Center in Riverton, KS, Galesburg USD 101, Maize USD 266, Rainbow United, Inc in Wichita, KS, St Mary's / Derby Schools, USD 505 St. Paul HS, USD 259 Wichita, USD 262 Valley Center.
- Purchase and Demolition of 91 structures in Independence, KS.
- Purchase and Demolition of 116 structures in Iola, KS.
- Flood Wall around critical utilities in Iola, KS.
- Purchase and Demolition of 28 residential structures in Montgomery County.
- Management Grant to hire to 2 additional state active duty employees.
- Purchase and Demolition of 28 structures in Neodesha, KS.
- Funds to help with the renewal / update of the State Hazard Mitigation Plan.
- Acquisition and Demolition of 18 properties in Wilson County.

DR-1699 – Greensburg Tornado, May 2007, Mitigation Funding $14,620,566

- Residential Safe Room program for substantially damaged homes that were in the flood plain in Chapman, KS - Approved
- Coffeyville Medical Center Safe Room - Awaiting Approval? (6-24-09 Awaiting SG Plan)
- Tornado Safe Rooms for Colwich / St Marks USD 267 - Approved
- Tornado Safe Room for Eudora Elementary - Approved
- Tornado Safe Room for Greensburg City Hall - Project Terminated
- Tornado Safe Room for Kiowa Hospital - Approved
- Funding for Osborne, Republic, and Woodson Counties Hazard Mitigation Plan - Approved
- Tornado Safe Room application for 16 schools in Wichita, KS - Approved

DR-1711 – Flooding, June 2007. Mitigation Funding $12,475,103

- Tornado Safe Room for Roseland, KS. – Approved
- Tornado Safe Room for Resurrection Catholic School - Approved
- McPherson, Clark, Grant, Morris, and Rooks County Mitigation Plans - All Approved
- Lyon Coffey REC, Radiant REC, Bluestem REC and Neodesha Electric. - Awaiting Approval
- Fanestil Meats buyout in Emporia, KS - Approved
- Neodesha buyout of 8 properties - Awaiting Approval
- Wabaunsee, Butler and Finney County Mitigation Planning Updates - Approved
- Three Safe Rooms for Cerebral Palsy Research Foundation - Approved

DR-1741 – Severe Winter Storms, December 2007. Mitigation Funding $38,553,054 estimated.

- Arkansas City 6 school safe room project – Approved
- Management Grant - Approved
- Greensburg School Safe Room - Approved
- Chapman Housing Authority - Approved
- Ewalt Elementary School Safe Room - Approved
- Circle School Safe Room - Approved
- Greely, Meade, and Cowley Count plans - Approved
- Victoria School Safe Room - Approved
- Andale and Garden Plains School Safe Room - Approved
- USD 348 Baldwin Primary Center Safe Room – Awaiting Approval
- USD 438 Baldwin City, Performing Arts Center – Awaiting Approval
- Chapman Elementary - Awaiting Approval
- Saline County Mitigation Plan - Approved
- Chapman Middle School - Awaiting Approval
- Chapman High School – Awaiting Approval
- State Mitigation Plan Update – Awaiting Approval ($150,000 fed share)
- David Brewer Elem. – Awaiting Approval ($700,092 fed share)
- Anthony Elem. – Awaiting Approval ($634,049 fed share)
- Southwest Elem. – Awaiting Approval ($490,042 fed share)
- Leavenworth High – Awaiting Approval ($1,501,232 fed share)
- Leavenworth LDAC – Awaiting Approval ($1,393,964 fed share)
- Basehor-Linwood High – Awaiting Approval ($1,125,000 fed share)
- Camp Alexander – Awaiting Approval ($94,427 fed share)
- Johnson County Corrections – Awaiting Approval
- Drywood Township Comm. Safe Room – Awaiting Approval
- 5% Warning Siren Program – 1.9 Million Fed Share
- (To be submitted soon: Auburn Washburn (PLAN) Safe Room, 9 Wichita School Safe Rooms, , 5% Warning siren application)
- Still have around $14 Million in Mitigation to use By 7-30-2009

DR-1776 – Severe Storms and Tornadoes, June 2008. Mitigation Funding $5,533,060 estimated.

- Will work on more of the same projects Buyouts, Tornado Safe Rooms, Retro fitting RECs, Planning Grants, and Flood Mitigation.

DR-1808 – Flooding, September 2008. Mitigation Funding $600,000 Estimated

- Will work on more of the same projects Buyouts, Tornado Safe Rooms, Retro fitting RECs, Planning Grants, and Flood Mitigatio

DR-1848 – Severe Winter Storms and Record and Near Record Snow (June 24, 2009 and March 26-29, 2009) Pending Information.

DR-1849 – Severe Storms, Flooding, Straight-line Winds, and Tornadoes (June 25, 2009) Pending Information.

DR- 1860 – Severe Storms and Flooding (September 30, 2009) Pending Information.

DR-1868 – Severe Winter Storm (December 23, 2009) Pending Information.

DR-1885 – Severe Winter Storms and Snowstorm (March 9, 2010) Pending Information.

While some of these projects help meet goals set in the previous plan, the KHMT revisited the state's goals and objectives to ensure that they reflect the state's reality three years later. The KHMT reviewed the goals and objectives to ensure projects such as these meet the state's goals and objectives. As indicated by the proposed spending of 2010 HMGP funding, these types of projects remain priorities and are aligned with a goal identified in this 2010 update (see Table 4.7).

Largely because of the amount of HMGP money available to the state, Kansas did not pursue funding from other FEMA grant programs, such as PDM, during this time period. Additionally, the FMA funding allocated to Kansas was not enough to do anything significant with and justify the associated administrative costs. With the HMGP funds dwindling, the state will continue to monitor the requirements and allocations of these programs, as well as the RFC and SRL programs, and submit applications as deemed appropriate by the KHMT.

5 COORDINATION OF LOCAL MITIGATION PLANS

This chapter focuses on three aspects of the state's involvement in local mitigation planning:

- Local Funding and Technical Assistance
- Local Plan Integration
- Prioritizing Local Assistance

5.1 Local Funding and Technical Assistance

IFR REQUIREMENT 201.4(c)(4)(i):	[The section on the Coordination of Local Mitigation Planning must include a] description of the State process to support, through funding and technical assistance, the development of local mitigation plans.
Explanation:	With a new requirement for local mitigation plans in DMA 2000, many communities will require additional assistance, particularly small communities without adequate resources to develop a plan. Therefore, the State **must** describe the process it has developed or will develop to provide funding and technical assistance to local jurisdictions to prepare mitigation plans. Funding sources may be Federal, State, or private (see page 1-47 of the Mitigation Strategies section). The description *should* include the departments or staff responsible for providing funds, plan development assistance, and technical assistance for developing risk assessments. This description could be included as part of the goals, objectives, and actions in the Mitigation Strategy section.

5.1.1 Background

The State of Kansas is committed to supporting a successful mitigation planning and programming effort at the local level. To date, this commitment has included financial and technical assistance for planning as well as project implementation.

For purposes of tracking the statewide mitigation planning effort, the counties are considered to be the primary local jurisdictions. There are 105 counties in Kansas. Based on information from the Federal Emergency Management Agency (FEMA), there are 40 county-level plans that have been approved by the agency; three school district plans, and one city-level plan has been approved by FEMA. There are a total of 281 jurisdictions approved by FEMA and another 198 jurisdictions approved pending adoption. Table 5.1 shows the status of the plans that are approved or approved, pending adoption.

Table 5.1.Status of Mitigation Plans

Approved (S) and (M) Jurisdictions	281
Approvable Pending Adoption (S) and (M) Jurisdictions	198
Approved Tribal Local (TL) Plans	0
Approvable Pending Adoption Tribal Local (TL) Plans	0
Approved Tribal (T) Plans	1
Approvable Pending Adoption Tribal (T) Plans	0
Total Jurisdictions (Approved + Approvable Pending Adoption)	481

Approved Standard State (SS) Plan	1
Approved Enhanced State (ES) Plan	0
Approved Tribal State (TS) Plans	0
Approvable Pending Adoption Tribal State (TS) Plans	0

5.1.2 Process to Provide Local Assistance

In early 2003, the Kansas Hazard Mitigation Team (KHMT) established a statewide program for local mitigation planning. The Kansas Division of Emergency Management (KDEM) is the coordinating body for local hazard mitigation planning. Its responsibilities include:

- Providing funding, as available, to develop local mitigation plans;
- Developing a schedule for completion of local mitigation plans;
- Establishing local mitigation planning criteria;
- Establishing standard methodologies for the identification of hazards, definition of vulnerabilities, and estimation of risk;
- Suggesting categories of critical facilities and systems that are to be addressed in local mitigation plans;
- Providing planning guidance and/or training for local jurisdictions;
- Providing technical support for local mitigation planning efforts;
- Establishing a procedure for receipt and review of completed local plans (including working with FEMA); and
- Implementing a process to monitor implementation of local mitigation plans.

In light of the number of disasters and the significant amount of Hazard Mitigation Grant Program (HMGP) funding received since 2008, the state has placed a renewed emphasis on the completion and adoption of FEMA approved plans for all Kansas counties by the time of the next state plan update in early 2013.

Since 2007, Kansas received eight major disaster declarations: Three disaster declarations in 2008 with FEMA-1741-DR Severe Winter Storm, FEMA-1776-DR Severe Storms, Flooding, and Tornado, FEMA-1808-DR Severe Storms, Flooding, and Tornado. There were four declarations in 2009 with FEMA-1848-DR Severe Winter Storms and Record and Near Record Snow, FEMA-1849-DR Severe Storms, Flooding, Straight-line Winds, and Tornadoes, FEMA-1860-DR Severe Storms and Flooding, and FEMA-1868-DR Severe Winter Storms. Since January of 2010 Kansas has received one disaster declaration, FEMA-1885-DR Severe Winter Storms and Snowstorm.

At the time of development of the 2004 plan, the state provided and encouraged counties to use Mitigation 20/20 software to develop and maintain their plans. Since then, the state has moved away from this program. In late 2005, KDEM purchased, for the sum of $300,000, the rights to use MitigationPlan.com, a web-based template driven software package produced by Visual Risk Technologies. This product was to be used to assist in writing state and local hazard mitigation plans. All counties were invited to training courses conducted by Visual Risk instructors on February 21, 22, and 23, 2006, in Topeka, Great Bend, and Garden City.

After reviewing local plans completed with both Mitigation 20/20 and MitigationPlanning.com, the state came to realize that boiler plate language and methodologies associated with such tools limit the levels of thinking and effort that are so critical to mitigation planning. In 2007 the state decided to discontinue the use of both Mitigation 20/20 and MitigationPlanning.com to develop state or local plans. KDEM decided the best approach would be for communities to use contractors to develop hazard mitigation plans for the communities. This would allow each

community to have its own plans in a format that was suitable for them. KDEM and FEMA arranged an informational meeting for contractors doing business with counties in Kansas. FEMA and KDEM discussed the mitigation planning criteria used by both agencies and what information is required, from the state's perspective, to roll up goals, objectives, and actions into the state plan.

Currently, FEMA is not providing aid to the state through technical assistance since the planning support was completed in late 2007. FEMA provided technical assistance in November 2009 with a G-318 Mitigation Planning Workshop for local governments to help local communities and contractors stay up-to-date with FEMA planning guidelines.

Using protocols provided by FEMA, such as the *Multi-Hazard Mitigation Planning Guidance under DMA 2000*, the "how-to" guides, and the Region VII Crosswalk, KDEM will help Kansas jurisdictions better understand the planning process and their hazard landscapes to allow the most beneficial projects to be selected. This will be an ongoing support function consisting of workshops as well as one-on-one meetings with individuals and committees to make sure that they receive the information that is required to complete an approvable hazard mitigation plan.

In addition to the planning guidance, training, and support offered by KDEM, there are several state agencies and programs that can provide local governments with technical assistance in their mitigation planning. Some of this assistance is described below. More information can be found in Section 4.2 State Capability Assessment.

- The Data Access and Support Center provides GIS data.
- The Kansas Department of Agriculture provides information and advice about food supply safety, flood control (floodplain management, dams and levees), and water availability.
- The Kansas Department of Commerce administers community development programs, which can help local governments incorporate mitigation into community development programs.
- The Kansas Department of Health and Environment helps local governments plan for response to major disease outbreaks and to protect the environment.
- The Kansas Forest Service helps with wildfire planning and is working to map the wildland-urban interface.
- The Kansas Geological Survey provides information about geological hazards in Kansas as well as surface and groundwater issues.
- The Kansas Water Office has developed guidelines for preparation of municipal water conservation plans. Technical assistance for plan preparation is provided by the Kansas Rural Water Association. The Kansas Water Office also has prepared a guide for local officials covering drought actions they should consider and available assistance.
- The State Conservation Commission works with local conservation districts to plan for watershed development and protection (including flood control and rehabilitation projects).

5.2 Local Plan Integration

Requirement §201.4(c)(4)(ii): [The section on the coordination of local mitigation planning must include a] description of the state process and timeframe by which the local plans will be reviewed, coordinated, and linked to the state mitigation plan. Update §201.4(d): [The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts, and changes in priorities.

IFR REQUIREMENT 201.4(c)(4)(ii):	[The section on the Coordination of Local Mitigation Planning must include a] description of the State process and timeframe by which the local plans will be reviewed, coordinated, and linked to the State Mitigation Plan.
Explanation:	The plan **must** include a description, as well as a timeline, of the State's approach for reviewing, coordinating, and integrating Local Plans into the statewide mitigation plan. An established process will streamline the review and approval of Local Plans, coordinate local and State planning efforts, and create a common knowledge base. While not required by the Rule, FEMA recommends listing the offices or departments responsible for these activities.
IFR REQUIREMENT Update §201.4(d):	[The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities.

5.2.1 Review and Approval of Local Plans

KDEM reviews submitted local mitigation plans within 45 days of receipt and, if necessary, offers guidance and recommendations to the local planning groups on how to improve the plans and/or make them better comply with federal requirements. Upon completion of the state-level review and incorporation of revisions by the responsible jurisdictions, local mitigation plans are forwarded to FEMA for federal review. FEMA conducts a similar review and works through KDEM to get necessary revisions made and issue approvals. Once FEMA is satisfied that plans meet federal requirements, they approve the plans "pending adoption." Once approved and pending adoption, it is then up to the local jurisdictions to formally adopt the plans and send copies of the adoption letters to FEMA through KDEM. FEMA officially approves the plans once the adoption letters are received. Only then are the local jurisdictions eligible for the benefits available to those with approved local hazard mitigation plans.

Although this process has not changed since 2004, it did not progress as quickly as originally intended. Reasons for why more county-level plans have yet to be completed or approved include: financial limitations; staffing constraints at the local level and at KDEM. Other reasons include, the state hazard mitigation officer position was vacant for a significant amount of time; complications with planning software; and lack of political will. The renewed emphasis on and funding for local mitigation planning should help address most of these issues.

There are 40 FEMA approved county-level hazard mitigation plans, three school district plans, and one city-level plan that together encompass 281 local jurisdictions. By the next plan update, KDEM anticipates that 104 of the 105 counties will have a FEMA approved hazard mitigation plan. With eight disasters in the last three years, KDEM would like to see all communities

eligible for HMGP funding to help protect their communities from future disasters. As it stands, there are 281 jurisdictions that can apply for project grants from the HMGP.

5.2.2 Linking Local Plans with the State Plan

In Kansas, there is a strong interest in integrating the state's mitigation plan and programs with the mitigation planning and programming efforts at the local level. While local jurisdictions should be using the state plan as a resource for their own plans, the KHMT recognizes the importance of using data developed through local planning processes in the state plan, since it is more relevant to community needs, desires, and capabilities. For all future state plan updates (the next update is scheduled for 2013), the state will review available local plans and consider the following for incorporation into the state plan:

- Identification of hazards and risk estimation
- Compilation of property value and populations at risk from the different hazards
- Identification of locally important critical facilities and their vulnerability
- Identification of rapidly developing communities
- Evaluation of local mitigation goals, programs, policies, regulations, and authorities
- Compilation of the local costs of disasters and the demonstrated value of preexisting mitigation initiatives
- Identification of local proposals for mitigation initiatives
- Implementation status of local mitigation initiatives

This information will be used to:

- Update the statewide mitigation strategy
- Support the statewide risk assessment process
- Create a comprehensive, statewide inventory of state and local critical facilities
- Identify jurisdictions with development pressures and assess the strength of the corresponding mitigation plans, policies, and programs
- Provide a basis for ongoing documentation and assessment of local mitigation strategies and actions
- Facilitate the efforts of KDEM to prioritize and select local mitigation actions for funding

Currently, the plans are integrated into the state plan during the update processes.

Plan drafts due to KDEM	Plan drafts due to FEMA	Final draft due to KDEM	Final plan drafts due to FEMA	Extension request due to KDEM
8 months after funding approval	30 days after received and state approved	30 days after FEMA approval	30 days after FEMA approval	90 days before end of obligation

5.2.3 Challenges in Plan Integration

At the time of this update, only 40 of 105 Kansas counties have FEMA approved hazard mitigation plans. There are several other plans at various stages of the development process. The KHMT analyzed goals and capabilities data from the 40 approved plans. As local plans are completed, the state will enter the local plan information into the database, which will include local hazard information, which goals and action items correlate with the state's goals and "Top 10" prioritized mitigation items. The newly developed database that integrates the local plan data and correlates it to the state plan information will allow KDEM to easily reflect changes in development and priorities with local plan information if necessary.

Another significant challenge to plan integration is the inconsistency of methodologies used to develop plans, specifically in regard to hazard identification and vulnerability assessment. Although the state tried to avoid this problem by providing software to local jurisdictions, the software has not been consistently used and applied across jurisdictions. The state is working to correct this problem for the plans that remain to be developed and for future local plan updates.

Source: FEMA News Photo

5.3 Prioritizing Local Assistance

IFR REQUIREMENT 201.4(c)(3)(iii):	[The section on the Coordination of Local Mitigation Planning must include] criteria for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs which should include: Consideration for communities with the highest risks, Repetitive loss properties, and Most intense development pressures. Further that for non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs.
Explanation:	The plan **shall** describe the criteria the State has developed for prioritizing local jurisdictions to receive planning and project grant assistance. Prioritization will assist the State in targeting the most at risk communities. The criteria for selecting communities *should* include those communities that are at highest risk, have repetitive loss properties, or are facing intense development pressure. The description can also include how assisting communities with their mitigation projects will achieve the plan's goals and objectives. For project grants, States **shall** explain how they will use benefit-cost reviews to determine which projects maximize benefits relative to their costs. These projects would have the highest priority for available funding.
IFR REQUIREMENT Update §201.4(d):	[The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities.

5.3.1 Criteria for Planning Grants

The HMGP requires local jurisdictions to have approved plans in order to receive project funding. In 2007, the state prioritized plans for all the counties in the state by offering to cover the 25% match for HMGP funds. All 105 counties (with the exception of one) applied for and received HMGP funds for plans and the state covered the 25% match for those counties. Most of these counties do not have local mitigation plans, but because they may be applying for project grants from the HMGP, FEMA has granted them waivers that will require them to have plans in place no later than one year of their project approval date in order to receive project funding. The state prioritized new plans over plan updates for funding; however, there were enough funds available to provide assistance to both. Currently, about sixty percent of the counties are still in the planning process phase to complete their plans. The new database for local mitigation plans will help the state address any changes in development over the next three years, when and if mitigation efforts and priorities change.

5.3.2 Criteria for Project Grants

KDEM, with guidance from the KHMT, is responsible for administration of state and federal grants that support local mitigation programming. The criteria for project grants presented in the original plan have been largely replaced by the "Project Priorities and Selection" process set forth in the State of Kansas Hazard Mitigation Grant Program Administrative Plan.

If it is necessary to select from a range of projects due to funding or other constraints, the governor's authorized representative/state hazard mitigation officer will, with the assistance of the KHMT, and other state agency staff members as required, evaluate and prioritize all eligible

applications. This ranking will be in accordance with the established KDEM criteria for funding of projects (see below). Projects must be in compliance with the minimum project criteria identified in 44 CFR 206.434:

- Be in conformance with the State Mitigation Plan and Local Mitigation Plan approved under 44 CFR part 201;
- Have a beneficial impact upon the designated disaster area, whether or not located in the designated area;
- Be in conformance with 44 CFR part 9, Floodplain Management and Protection of Wetlands, and 44 CFR part 10, Environmental Considerations;
- Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed. Projects that merely identify or analyze hazards or problems are not eligible; and
- Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. The grantee must demonstrate this by documenting that the project:
  - Addresses a problem that has been repetitive, or a problem that poses a significant risk to public health and safety if left unsolved;
  - Will not cost more than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future disasters were to occur (both costs and benefits will be computed on a net present value basis);
  - Has been determined to be the most practical, effective, and environmentally sound alternative after consideration of a range of options;
  - Contributes, to the extent practicable, to a long-term solution to the problem it is intended to address; and
  - Considers long-term changes to the areas and entities it protects, and has manageable future maintenance and modification requirements.

KDEM uses the following criteria to determine project eligibility and to assist in prioritizing projects.

- **Federal Eligibility Criteria**—All projects must meet other relevant program-specific federal eligibility criteria in addition to those listed above.
- **Protection of Lives**—Projects that eliminate potential loss of lives will be given priority one.
- **Permanency of the Project**—Mitigation activities that offer a permanent solution to the problem at hand.
- **Elimination vs. Reduction of Probability of Occurrence**—Projects that eliminate the risk from one or multiple hazards will be selected over projects that merely reduce the likelihood of damage from occurring.
- **Extent of Damage**—Significance of damage to structures located in the proposed project area.
- **Repetitive Loss**—Documentation of repetitive loss, due to the same hazard, in the proposed project area.
- **Existing Protection**—Flood-prone areas offered minimal or no protection by U.S. Army Corps of Engineers certified structures are given priority.

- **Economic Impact to the Community**—Magnitude of impact based on the community's ability to absorb the loss.
- **Mitigation Plans**—Mitigation projects should be in conformance with state and local mitigation goals and objectives.
- **Level of Risk**—Communities with the highest level of risk (e.g., largest population at risk) will be given special consideration.
- **Development Pressures**—Projects may be needed to mitigate risk intensified by development pressures in known hazard areas (e.g., where populations are growing).

5.3.3 Successes and Challenges of Prioritization

To simplify administration of the state's mitigation program, the KHMT streamlined the plan's prioritization process so that it is more consistent with the existing process established by the State of Kansas Hazard Mitigation Grant Program Administrative Plan. The state now has one set of criteria for project prioritization that can be expanded upon as necessary based on the requirements of the particular grant program being pursued. Also, the new database will help with integrating the local plans with the state plan for prioritizing mitigation efforts with both the state and local plans.

Source: FEMA News Photo Greensburg, Kansas

6 PLAN MAINTENANCE PROCESS

This chapter focuses on two aspects of the process Kansas uses to maintain the Kansas Hazard Mitigation Plan:

- Monitoring, evaluating, and updating the plan
- Monitoring progress of mitigation actions

6.1 Monitoring, Evaluating, and Updating the Plan

IFR REQUIREMENT 201.4(c)(5)(i):	[The Standard State Plan Maintenance Process must include an] established method and schedule for monitoring, evaluating, and updating the plan.
Explanation:	The plan maintenance process provides a framework for gauging progress and adjusting to new conditions, such as new policies, Federal requirements, and new initiatives. The State **must** describe how, when, and by whom the plan will be **monitored**. For example, its monitoring system may consist of the submittal of periodic reports by agencies involved in implementing projects or actions; site visits, phone calls, and meetings conducted by the person responsible for overseeing the plan; and the preparation of an annual report that captures the highlights of the previously mentioned activities. The State plan **must** also include a description of how, when, and by whom it will be **evaluated**. The description *should* include the criteria used to evaluate the plan, such as whether: The goals and objectives still address current and expected conditions. ▪ The nature and magnitude of hazard problems and/or development have changed. The current resources are appropriate for implementing the plan. ▪ There are implementation problems, such as technical, political, legal, or coordination with other agencies. The outcomes of actions have been as expected. The agencies participated as originally proposed. Ideally, the plan *should* be evaluated on an annual basis to determine the effectiveness of programs, policies, and projects, as well as to reflect changes in priorities and regulations. The plan **must** describe how, when, and by whom it will be **updated**. FEMA recommends identifying the interested parties to be included in the process.

With KDEM having sufficient staff from 2007 to 2009, the hazard mitigation plan was revisited at the KHMT meetings over the period of two years to determine the plan's effectiveness of policies, programs and procedures. Each chapter of the plan was addressed separately over the period of time and discussed in a round-table format. During that period, the plan was

considered by the team to be effective and no new updates to the plan were recommended by the KHMT until the start of the 2010 planning process.

The state followed the process outlined for monitoring, evaluating, and updating the plan during the previous update.

The KHMT continued to be active with disaster declarations (11 since January 2007) and meetings coordinated as part of the plan update process. The state hired a consultant to facilitate the update process since the KDEM staff was stretched thin over the past few years with several disaster declarations. The previous plan update process revitalized the KHMT, which made a new commitment to meet on a quarterly basis, with flexibility for disasters or other events.

The KHMT determined that the previous plan update was more effective than the original plan. The previous update streamlined the plan and made it more user-friendly. The 2004 plan, developed with Mitigation 20/20, was difficult with the number of attachments and tables. The KHMT decided not to use this program again and evaluated another mitigation-planning tool, MitigationPlan.com, as an alternative. Technical issues and incompatibilities with the Mitigation 20/20 plan ultimately led to a decision to abandon both tools for a format that would be more consistent with the Federal Emergency Management Agency (FEMA) planning guidance and other state plans. The previous update abandoned much of the old language from Mitigation 20/20 and contained a more updated process for monitoring, evaluating, and updating the plan. The 2010 update used a new database to integrate local plan data with the state plan. The KHMT felt the need for a database with the growing number of local hazard mitigation plans being approved (40) compared to the eight that were approved in the previous update.

The KHMT found the current monitoring, evaluating, and updating method was very effective and found that the biggest change would be in updating future plans using the new local plan database for incorporating local plan data into future plan updates.

6.1.1 Plan Monitoring and Evaluation

This section describes the actions that will be taken by the KHMT and participating agencies to monitor implementation of the Kansas Hazard Mitigation Plan and to evaluate its effectiveness in reducing the vulnerability of Kansas to future disasters. The plan's monitoring and evaluation process assesses progress made in plan implementation, emphasizing the state's efforts to achieve the plan's mitigation goals and objectives through completion of identified actions. The committee found the method to be adequate for monitoring the plan.

Monitoring and evaluating the state plan will occur through regular meetings of the KHMT. The KHMT will meet quarterly, with flexibility, and following major disasters to review implemented actions (e.g., status, successes, and challenges), coordinate activities, address new business or opportunities, and review progress of local plan development. Annual plan reviews will be conducted to examine the state's mitigation programming more comprehensively. At these annual meetings, the KHMT will evaluate the plan in the context of the state's current hazard environment, vulnerabilities, funding availability and needs, as well as federal and state policy

changes. For the annual plan review, in addition to the activities conducted at the quarterly meetings, the KHMT will focus on the following questions (criteria) to evaluate the plan:

- Does the state have the resources it needs to continue implementing the plan as written (e.g., funding, technical, and staffing resources)?
- Are there new hazards that threaten the state or new vulnerabilities that require a shift in hazard priorities?
- Are the goals and objectives still relevant?
- Have there been any changes in state capabilities (gained or lost)?
- Are the actions being implemented as planned?
- Are the actions helping to meet goals and objectives?
- Can action effectiveness be documented?
- Has the process to monitor and evaluate the plan been effective?

Information at the quarterly and annual meetings will be collected and incorporated into the three-year update (see Section 6.1.2 Plan Updating and Maintenance). Changes or amendments to the plan may be made prior to the official plan update as necessary to address significant changes in priorities or federal and state regulations, statutes, or policies. These changes will be submitted to FEMA as part of the official three-year plan update or as required by FEMA.

Schedule for Plan Monitoring and Evaluation

The KHMT will meet once every quarter. Annual plan reviews will be conducted at the July 2011, 2012, and 2013 meetings of the KHMT. The July 2013 review will be incorporated into the 2013 update; it will not mark the beginning of the 2013 update process, which is scheduled to begin in January 2013.

Responsibility for Plan Monitoring and Evaluation

The KHMT is charged with the overall responsibility for plan monitoring and evaluation. KDEM, in its capacity as support agency to the KHMT, is responsible for coordination and leadership of the KHMT. KDEM's responsibilities for monitoring and evaluating the plan include the following:

- Communicating the schedule and activities for plan updating and maintenance to the KHMT
- Facilitating meetings of the KHMT
- Assisting other agencies with the implementation of mitigation actions
- Coordinating with agencies between KHMT meetings
- Coordinating and conducting outreach to other stakeholders or interested parties and the public
- Obtaining local mitigation plan data to be used in plan update cycles
- Conducting all plan evaluation and monitoring activities that are not otherwise assigned to another agency
- Monitoring, capturing, and communicating mitigation success stories
- Documenting and incorporating the findings of the evaluation and monitoring analyses into the next edition of the Kansas Hazard Mitigation Plan

- Updating the KHMT on mitigation grant funds available or dispersed for actions
- Engaging and maintaining the interest of the agencies participating on the KHMT

Keeping the KHMT alongside changes or opportunities with FEMA mitigation grants or policies

- Monitoring progress of local mitigation plan development and providing technical and financial assistance

As participants of the KHMT, state agencies have the following responsibilities for plan monitoring and evaluation:

- Participating in meetings of the KHMT
- Leading the implementation of their agency's respective mitigation action(s)
- Providing progress reports on their agency's respective mitigation action(s)
- Monitoring and documenting disasters of significance to state agencies and providing this information to KDEM
- Suggesting plan revisions to reflect changes in priorities, regulations, policies, or procedures
- Taking action as needed to effectively monitor and evaluate the agency's role in the planning process

Local mitigation planning groups in Kansas also have responsibilities to support the state's efforts to monitor and evaluate the statewide mitigation program. These local responsibilities include the following:

- Providing initial and updated local mitigation plan data to KDEM
- Maintaining and enhancing participation in the local mitigation planning process
- Tracking data regarding the implementation status of local mitigation actions
- Tracking changes in the number of people and property at risk, the vulnerabilities of critical facilities, and the development of mitigation-related policies to understand how the local mitigation plan is influencing community-level mitigation capabilities
- Tracking actions proposed and completed that address local mitigation goals and objectives as well as the vulnerabilities of previously assessed facilities and neighborhoods
- Conducting other monitoring and evaluation activities that would be unique to their jurisdiction and its local mitigation planning and programming

6.1.2 Plan Updating and Maintenance

The state's system for updating and maintaining the mitigation plan will be implemented through ongoing activities. KDEM will maintain a file to capture information valuable for the next update of the plan. This file will include the following:

- Records of all KHMT meetings, including agendas, sign-in sheets, minutes, and other handouts
- Documentation of interim plan reviews
- Recommendations made from interim plan reviews

- Records of notable disasters for hazard identification and risk assessment profile updates
- New reports or studies on hazards and vulnerability
- Mitigation success stories
- Annual reports from the Adjutant General's Department and the Commission on Emergency Planning and Response (and others as available)

State agencies participating on the KHMT should maintain similar files of information that will be useful to the update process. The process of updating the plan will follow the information used in the previous update, which is outlined in Section 2.1.2 2010 Plan Update Process. It will also incorporate updated FEMA state plan update guidance as appropriate.

Schedule for Plan Updating and Maintenance

Updates to state plans are required by FEMA every three years. The next update of the Kansas Hazard Mitigation Plan will need to be reapproved by FEMA by November 2013. The KHMT will aim to complete the plan by early October of the year the update is due, to allow enough time for FEMA to review the plan and for the state to readopt it. The plan will need to be readopted by the Governor's Authorized Representative, the Adjutant General, Director of Emergency Management and Homeland Security.

At the January 2010 KHMT meeting, KDEM issued a schedule for the KHMT for the 2010 state plan update. This schedule established a timeline for the following (and other activities as needed):

- KHMT plan update meetings
- Determining involvement and activities of newly participating state agencies (as well as changes in existing ones), including identification of critical facilities, assessment of vulnerabilities, analysis of programs and policies, and identification of new mitigation actions
- Updating the status of mitigation actions identified in the previous update
- Contracting consultant assistance, as necessary

Responsibility for Plan Updating and Maintenance

KDEM, as the designated support agency for the KHMT, has the primary responsibility for ensuring that the Kansas Hazard Mitigation Plan is updated and maintained. In this coordination role, KDEM will do the following:

- Schedule and facilitate meetings of the KHMT in every quarter (this includes the annual meetings to be held each July, kicking off the 2010 update on December 2, 2009)
- Track completion of mitigation actions
- Solicit the involvement of additional public and private sector participants in the statewide mitigation planning process
- Issue public notices to solicit public input during each planning cycle and manage the receipt and documentation of public input
- Print and publish updates of the Kansas Hazard Mitigation Plan
- Coordinate and implement a state-level "after action" review of disasters of statewide significance to document the impacts, review the effectiveness of pre-existing mitigation

actions, and define the need for new actions to be proposed and incorporated into the Kansas Hazard Mitigation Plan

- Manage and administer the local mitigation planning process, including establishing a schedule for submittal of local plan updates (initial plans should all be complete by the 2010 update); providing technical guidance and training to local mitigation planning organizations; reviewing and commenting on submitted local mitigation plans; and facilitating the federal review of local mitigation plans
- Incorporate available local mitigation plan data into the state plan and advise the KHMT on the implications of the local data to statewide mitigation planning and programming
- Conduct periodic reviews and evaluations of the progress in implementing the Kansas Hazard Mitigation Plan and in achieving state-level mitigation goals and objectives
- Serve as the point of contact for the KHMT and the agencies participating in the plan
- Take other actions as necessary to maintain and expand the Kansas Hazard Mitigation Plan

Source: FEMA News Photo Kansas City, KS

All agencies participating in the statewide mitigation planning process will do the following to fulfill their responsibilities for updating and maintaining the Kansas Hazard Mitigation Plan:

- Cooperate with requests from KDEM for updated or new technical data relevant to the agency and mitigation plan
- Assign staff, as indicated or on request, to attend meetings of the KHMT
- Complete assigned mitigation actions when assigned as the lead agency, or assist the designated lead agency as a support agency
- Propose mitigation actions to reduce vulnerabilities to future disasters and endeavor to implement the proposed mitigation actions as the resources and/or opportunities become available
- Cooperate with efforts for program coordination and/or with consolidation when appropriate
- Serve as a technical resource for local mitigation planning groups, when indicated

Source: FEMA News Photo: Greensburg, KS

6.1.3 Successes and Challenges to Monitoring, Evaluating, and Updating the Plan

As previously mentioned, disaster declarations tied up KDEM staff, which was already short-handed, during much of the 2004 to 2007 update cycle, hindering regular meetings of the KHMT. A new state hazard mitigation officer was hired in 2006, which improved coordination and regular meetings of the KHMT. FEMA Hazard Mitigation Grant Program funding for the previous update contributed to the success of the update process by funding consultant expertise to facilitate and manage the process.

The state also experienced many challenges with mitigation planning software programs in the past three years. The move away from these programs has been a positive one and resulted in an improved plan, both in terms of content and usability.

6.2 Monitoring Progress of Mitigation Actions

IFR REQUIREMENT *201.4(c)(5)(ii) and (iii):*	[The Standard State Plan Maintenance Process must include a] ▪ System for monitoring implementation of mitigation measures and project closeouts. ▪ System for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.
Explanation:	The plan **must** describe the State's monitoring system for tracking the initiation and status of projects as well as project closeouts, indicating who will be responsible for implementing and maintaining this system. This is important because without regular monitoring, mitigation actions may not be implemented as planned. The plan **must** also describe how the State reviews the progress made on actions and projects and how well these contribute to achieving the plan's goals. The description **must** also include who is involved in the review and what the timeframe is for carrying out the review.

This section describes the state's system for monitoring implementation of mitigation actions and reviewing progress toward meeting plan goals. This introduction describes changes in the system since the previously approved plan.

The system described below is similar in many ways to the previous one. It still relies on a quarterly meeting schedule with annual plan reviews, and the lines of responsibility are similar to those in the previous plan. It also uses a structured mitigation strategy to review overall progress toward meeting goals. The KHMT decided that despite problems with using the system during the last plan cycle, these were important elements to keep and that improved resources in funding and staffing and heightened awareness of disaster impacts would help to keep them on track. The primary changes in the updated system include the methods, including a database, for tracking progress of mitigation actions that were put in place as part of this planning process and will be carried forward by KDEM and the KHMT.

6.2.1 Monitoring Action Implementation and Closeouts

As part of the plan update, each agency participating on the KHMT completed a mitigation action progress worksheet providing the status on mitigation actions from the previous update for which they were the designated lead agency. The results of these progress worksheets were compiled into a database tracking the status of all identified state mitigation actions. Actions from the previous plan update were labeled as completed, ongoing, or uncompleted. If uncompleted, they were marked as deferred (because they should still be incorporated into the updated plan), deleted (because they are no longer relevant), or revised. New actions identified by the KHMT as part of the 2010 plan update were added to the database and will be tracked moving forward. The results of this review are discussed in Section 4.4.1 Identifying, Evaluating, and Prioritizing Mitigation Actions and Appendix N Mitigation Action Details.

This approach forms the basis for the state's system for monitoring implementation of mitigation actions and reviewing the progress of its mitigation strategy. The KHMT will meet on a quarterly basis as previously discussed. Each year, the July meeting will serve as the meeting for annual plan review. In association with the annual plan review, state agencies will complete mitigation action progress worksheets on the actions for which they are responsible. The progress worksheets will capture whether implementation has begun, and, if so, the approximate percent completion as of the assessment date. If implementation has been completed, the date of

completion will be documented. If the agency no longer intends to implement the action, it is classified as deleted. KDEM will update the state mitigation action database with the new information. At the meeting, the KHMT will review the current implementation status of all actions and modify priorities and methods as needed.

During quarterly meetings, the KHMT will review implemented actions, including those funded through FEMA. This schedule will be consistent with progress reporting on FEMA-funded state or local mitigation actions, which occurs on a quarterly basis. Subgrantees are required to submit quarterly reports to KDEM 15 workdays after the end of each federal quarter. Quarterly reports will be summarized by KDEM and provided to FEMA no later than 30 days after the end of each federal quarter. Site visits, telephone conversations, and quarterly reports will be used to monitor and track the progress of actions funded with FEMA mitigation grants.

The KHMT will use the state mitigation action database to sort out implemented actions and track specific information, such as funding sources, action types, closeouts, and eventually, effectiveness. KDEM already maintains a database of property buyouts that tracks where properties have been removed from the floodplain. This database could be linked or expanded to track all implemented actions. By spatially linking the database with GIS, the state could map locations of mitigation actions.

The state will also update the database after disasters and will evaluate action effectiveness, if possible. For example, after a disaster, KDEM could contact the local entity where an action has been implemented to determine if it was effective in reducing losses or saving lives. These results would be assessed to inform future planning processes. Documented success stories will be posted on the KDEM website.

Monitoring implementation status of mitigation actions will occur at the state and local levels. Monitoring the implementation of local mitigation actions and linking these to state actions will be challenging and requires a shared responsibility between the state and local governments. The development of a local mitigation actions database is being implemented during this plan update. The database will be used to facilitate the tracking of proposed and implemented local mitigation actions and will serve to strengthen the link between local and state mitigation actions and inform future-plan updates.

KDEM is responsible for the overall continued management and maintenance of the monitoring system for the Kansas Hazard Mitigation Plan. The agencies of the KHMT are responsible for tracking the status and implementation of actions for which they are the designated lead agency. KDEM, as the state agency responsible for management of FEMA mitigation funds, is also responsible for monitoring the progress, implementation, and closeout of any state or local mitigation actions funded by the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, Repetitive Flood Claims program, and Severe Repetitive Loss program.

Final closeout and audit procedures are the responsibility of the lead agency for that action. For purposes of the KHMT, documentation of completion by the sponsoring organization constitutes closeout. KDEM will assist agencies on the reporting and closeout of FEMA funded actions (e.g., HMGP funds and PDM grants administered by KDEM with state or local eligible agencies

as the subgrantee will be closed out in accordance with the established requirements of the FEMA grant). HMGP closeout procedures are detailed in the State of Kansas Hazard Mitigation Grant Program Administrative Plan (DR-1885-KS, 2010).

6.2.2 Reviewing Progress on Achieving Goals

The Kansas Hazard Mitigation Plan includes provisions to review progress toward achieving the identified mitigation goals and objectives. Because goal statements are normally phrased as idealized future conditions, they may not be fully attainable and are difficult to measure. By breaking goals down into more specific and measurable objectives and actions, the KHMT is able to monitor progress toward achieving goals.

In identifying mitigation actions, the KHMT focused on those actions intended to further specific plan goals and objectives, which is shown in Section 4.4.2 2010 Updated Mitigation Actions. During each plan update cycle, the KHMT will use the state mitigation action database previously described to summarize progress on the plan's mitigation actions. For each plan goal and objective, the status of associated actions will be assessed.

The Kansas mitigation strategy links actions specifically with objectives and goals. Thus, progress toward achieving goals is directly measurable by the actions that are completed. Actions may contribute to meeting more than one objective or goal but are linked with only one objective and goal for tracking purposes. Many actions in the plan will be ongoing and progress will have occurred even though the action is not designated as "completed."

The KHMT may use quantitative measures to assess the progress of some actions. An example is the increase in number of participants in the National Flood Insurance Program or Community Rating System over time. Other quantitative measures of progress may include the change in the numeric risk estimates for different hazard types and local jurisdictions. Changes in the estimated number of people and the dollar value of state and local property at risk from different hazard types, and mitigation grant funding dispersed over time, are also included. Many mitigation actions are related to agency coordination or education and training, thus it is difficult to gauge the actual cost-benefit or future losses avoided. Progress on these actions may be quantified through the number of workshops conducted or partnership initiatives developed.

The review of progress is the responsibility of the agencies and stakeholders of the KHMT and will be facilitated by KDEM. It is also the responsibility of local jurisdictions to notify KDEM when a mitigation action successfully reduced losses to lives or property. KDEM will initiate this review as part of the plan update process every three years.

6.2.3 Successes and Challenges to Monitoring Progress of Mitigation Actions

For the 2010 update, progress on all actions was solicited from the lead agency associated with each action. One of the challenges in obtaining the progress status of each action was a turnover in state staff. It was often difficult for new KHMT members to track down who was associated with the mitigation action originally. Continued regular meetings of the KHMT should resolve these issues in the future. The nature and overwhelming number of “tasks” and “initiatives” in the previously approved plan also created difficulties in implementing actions and monitoring progress. Tracking future progress should be improved by the consolidating and prioritizing of ongoing and new mitigation actions that occurred during the update process.

The state has made progress completing several mitigation actions, despite staff limitations and limited funding. These actions are identified in Section 4.4.1 Identifying, Evaluating, and Prioritizing Mitigation Actions and Appendix N Mitigation Action Details. Many of the completed actions could be implemented within existing state agency programs and budgets. These will remain a focus in identifying effective and achievable mitigation actions in the future. Another challenge during the 2010 plan update was that only about 38% of local governments in Kansas had FEMA approved local mitigation plans. Only jurisdictions with approved mitigation plans are eligible for mitigation funding at this time. Disasters in 2008, 2009, and 2010 reemphasized the importance of these local plans.