

Douglas County Multi-Jurisdictional Multi-Hazard Mitigation Plan

December 2008

Developed by AMEC Earth and Environmental, Topeka, KS

Homeland Security and Emergency Management Programs

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HAZARD MITIGATION PLANNING COMMITTEE

Participant	Representing
Kathy Allen	Shawnee County Emergency Management
Greg Anderson	Wakarusa Township Fire Department
Matt Bond	Lawrence Stormwater
Lyle Bowlin	Willow Creek Township Fire Department
Nick Crossley	Johnson County Emergency Management
Keith Dabney	Douglas County Zoning and Codes Department
Greg Dahlem	Eudora Police Department
Sheila Dale	Osage County Emergency Preparedness
August Dettbarn	Douglas County Appraiser's Office
Jeff Dingman	Baldwin City Administration
Paul Dorathy	Baldwin City USD #348
Sharon Dwyer	Rural Water District #5, Lawrence
Kim Ens	Lawrence - Douglas County Health Department
Mike Fangman	Clinton Township Fire Department
Rick Gammill	Lawrence USD #497
Greg Gardner	US Department of Homeland Security, IPP
Don Grosdidier	Eudora USD #491
Jason Hartman	Kansas Forester
Rick Hird	Rural Water District #2, Lawrence
Larry James	Rural Water District #6, Lecompton
David Mackler	Rural Water District #4, Baldwin City
John Marmon	University of Kansas Emergency Management
Sheila Meggison	Douglas County Emergency Management
Amy Miller	Lawrence Floodplain Manager
Rick Miller	Douglas County GIS and Mapping
Ron Olin	Lawrence Police Department
Mike Perkins	Douglas County Public Works & Road and Bridge
H. Wayne Riley	Lecompton Fire District #1
David Rhodes	USACE, Clinton Lake
Bob Rombach	University of Kansas
Pam Schmeck	City of Eudora Administration
Micah Seybold	City of Lawrence GIS and Mapping
Teri Smith	Douglas County Emergency Management
William Stark	Lawrence Douglas County Fire Medical
Pat Talkington	Lawrence Douglas County Fire Medical
Justin Van Winkle	City of Lecompton Public Works
Kari Wempe	Douglas County Sheriff's Office
Bill Winegar	Baldwin City Public Works
Billy D. Wood	Douglas County Extension Agent
Denis Yoder	Perry - Lecompton USD #343
Richard Zeisenis	Lawrence - Douglas County Health Department

Other Key Contributors:

Kansas Division of Emergency Management, Office of Hazard Mitigation

Kansas Department of Health and Environment

Kansas Department of Agriculture, Division of Water Resources

Kansas Forest Service

AMEC Earth and Environmental (Ida Kirmse, Susan Belt, Jayson Wilson)

EXECUTIVE SUMMARY

Each year, natural disasters in the United States take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars each year to help communities, organizations, businesses, and individuals recover from disasters. These losses only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Additionally, many natural disasters are predictable. Many more are repetitive, often with the same results. Many of the damages caused by these events can be alleviated or even eliminated.

FEMA, now a part of the U.S. Department of Homeland Security, has made reducing losses from natural disasters one of its primary goals. Hazard mitigation planning and subsequent implementation of projects, measures, and policies developed through those plans, is the primary mechanism in achieving these goals. Mitigation planning has resulted in the implementation of projects that have successfully reduced disaster damages.

This plan was developed pursuant to the regulations of the Disaster Mitigation Act (DMA) of 2000. The DMA revises the Robert T. Stafford Disaster Relief and Emergency Assistance Act by adding Section 322, which provides new and revitalized emphasis on hazard mitigation, including a new requirement for local mitigation plans. These new local mitigation planning regulations are implemented through 44 CFR Part 201.6.

The DMA requires state and local governments to develop multi-hazard mitigation plans to maintain their eligibility for certain federal disaster assistance and hazard mitigation funding programs. Communities at risk from natural disasters cannot afford to jeopardize this funding.

More importantly, proactive mitigation planning at the local level can help reduce the cost of disaster response and recovery to property owners and government by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. Douglas County and its participating jurisdictions have been affected by several disasters in the past and are committed to reducing disaster impacts and maintaining eligibility for federal mitigation grant funding.

Natural hazards mitigation is defined as sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Natural hazards mitigation planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies that would lessen the impacts are determined, prioritized, and implemented. This plan documents the natural hazards mitigation planning process for Douglas County, identifies natural hazards and risks within the county, and identifies the hazard mitigation strategy of the participating jurisdictions to reduce vulnerability and make the communities of Douglas County more disaster resistant and sustainable. Information in this plan can be used to help guide and coordinate mitigation activities and local land use decisions.

PREREQUISITES- PARTICIPATION INFORMATION

44 CFR requirement 201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

The following jurisdictions and special districts that meet the FEMA definition of “local government” participated in the development of this plan and have adopted the multi-jurisdictional plan. Resolutions of Adoptions are included on the following pages. (The plan will be adopted and resolutions included for each participating jurisdiction after preliminary approval from the Kansas Division of Emergency Management and the Federal Emergency Management Agency.)

- Douglas County, Lead Agency
- City of Baldwin City*
- City of Eudora
- City of Lawrence
- City of Lecompton
- Clinton Township
- Lecompton Township
- Wakarusa Township
- Rural Water District #2, Lecompton
- Rural Water District #5, Lawrence
- Rural Water District #6, Lecompton
- USD #497 Lawrence
- USD #343 Perry - Lecompton
- USD #348 Baldwin City
- USD #491 Eudora
- University of Kansas
- Baker University

The participating jurisdictions marked with an asterisk (*) participated by designating an authorized representative to act on their behalf. Resolutions for authorized representatives are included in Appendix D.

CHAPTER 1 PLANNING PROCESS

44 CFR Requirement 201.6(c)(1):[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

44 CFR Requirement §201.6(a)(3): Multi-jurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

The Disaster Mitigation Act of 2000 requires all local governments to assess their risks to natural hazards and identify actions that can be taken in advance to reduce future losses. The law requires all local governments and districts to have an approved Multi-Hazard Mitigation Plan after November 1, 2004, to be eligible for certain federal disaster assistance and hazard mitigation funding programs.

To assist Douglas County in the preparation of the mitigation plan, the State of Kansas Division of Emergency Management (KDEM) awarded a contract to Douglas County who in turn contracted with AMEC Earth and Environmental. AMEC's role is to assist Douglas County with the completion of a FMEA-approved multi-jurisdictional local hazard mitigation plan, meeting the requirements of the Disaster Mitigation Act of 2000.

The Douglas County Emergency Management Agency has taken the lead in developing this plan. AMEC has assisted by facilitating the planning process, collecting the necessary data from planning committee members and other sources as indicated throughout the plan, and performing other technical services, including preparation of the risk assessment and plan document.

AMEC and the Douglas County Emergency Management Agency worked together to establish the framework and process for this planning effort using FEMA's Multi-Hazard Mitigation Planning Guidance under the Disaster Mitigation Act of 2000 (2004) and the State and Local Mitigation Planning How-To Guides (2001), which includes the Multi-Jurisdictional Mitigation Planning How-To Guide (2006). The plan is structured around a four-phase process:

- 1) Organize Resources
- 2) Assess Hazards and Risks
- 3) Develop a Mitigation Plan
- 4) Evaluate the Work

The remainder of this chapter provides a narrative description of the steps taken to prepare the hazard mitigation plan.

1.1 Phase I: Organize Resources

Step 1: Get Organized

It was determined at the onset, that this plan would be a multi-jurisdictional plan with Douglas County Emergency Management Agency serving as the lead agency. They sent out invitations for the kick-off meeting to all municipalities and special districts within the planning area as well as state, federal, and volunteer organizations that could contribute to the planning process. Each jurisdiction that chose to participate in the planning process and development of the plan was required to meet strict plan participation requirements defined at the beginning of the process, which included the following:

- Designate a representative to serve on the Douglas County Hazard Mitigation Planning Committee (HMPC)
- Participate in HMPC meetings
- Provide data and information to complete the plan, identify at least one mitigation action and complete action implementation worksheets
- Review and comment on plan drafts
- Inform the public, local officials, and other interested parties about the planning process and provide an opportunity for them to comment on the plan
- Formally adopt the mitigation plan

The table below shows the attendance of representatives at each HMPC meeting. Sign-in sheets are included in Appendix A.

Table 1.1 Participation in HMPC Meetings

Name	Meeting 1	Meeting 2	Stakeholder Meeting	Meeting 3	Jurisdiction/Department
Kathy Allen	X	X			Shawnee County Emergency Management
Greg Anderson	X				Wakarusa Township Fire Department
Matt Bond	X			X	Lawrence Stormwater
Lyle Bowlin	X				Willow Creek Township Fire Department
Nick Crossley	X				Johnson County Emergency Management
Keith Dabney	X	X			Douglas County Zoning and Codes Department
Sheila Dale	X	X			Osage County Emergency Preparedness
Greg Dahlem		X		X	Eudora Police Department
August Dettbarn	X				Douglas County Appraiser's Office
Jeff Dingman			X	X	Baldwin City Administration
Paul Dorathy			X		Baldwin City USD #348
Sharon Dwyer	X				Rural Water District #5, Lawrence
Kim Ens	X	X			Lawrence - Douglas County Health Department
Mike Fangman	X	X			Clinton Township Fire Department

Name	Meeting 1	Meeting 2	Stakeholder Meeting	Meeting 3	Jurisdiction/Department
Linda Finger		X			Douglas County Administration and Planning
Rick Gammill	X	X		X	Lawrence USD #497
Greg Gardner	X				US Department of Homeland Security, IPP
Michael Grob		X			Wakarusa Township Fire Department
Don Grosdidier		X	X		Eudora USD #491
Jason Hartman	X	X			Kansas Forester
Mark Hecker		X			City of Lawrence Parks and Recreation
Rick Hird	X			X	Rural Water District #2, Lawrence
Larry James	X				Rural Water District #6, Lecompton
Sandy Johnson		X			Kansas Department of Agriculture
David Mackler	X				Rural Water District #4, Baldwin City
John Marmon	X	X	X	X	University of Kansas Emergency Management
Sheila Meggison		X		X	Douglas County Emergency Management
Amy Miller	X	X			Lawrence Floodplain Manager
Rick Miller	X				Douglas County GIS and Mapping
Tom Morey		X			Kansas Department of Agriculture
Ron Olin	X				Lawrence Police Department
Mike Perkins	X	X			Douglas County Public Works & Road and Bridge
H. Wayne Riley	X	X		X	Lecompton Fire District #1
David Rhodes	X	X			USACE, Clinton Lake
Chad Rine		X			Baldwin City Police Department
Bob Rombach	X				University of Kansas
Pam Schmeck	X	X		X	City of Eudora Administration
Micah Seybold	X	X			City of Lawrence GIS and Mapping
Teri Smith	X			X	Douglas County Emergency Management
William Stark	X				Lawrence Douglas County Fire Medical
Pat Talkington	X				Lawrence Douglas County Fire Medical
Justin Van Winkle	X	X			City of Lecompton Public Works
Kari Wempe		X		X	Douglas County Sheriff's Office
Bill Winegar		X	X		Baldwin City Public Works
Billy D. Wood	X	X			Douglas County Extension Agent
Denis Yoder	X				Perry - Lecompton USD #343
Richard Zeisenis	X			X	Lawrence - Douglas County Health Department

Meeting Dates and Agendas

Meeting	Date	Agenda Items
Kickoff Meeting	4/18/2008	Introduction to the DMA, the Planning Process, Hazard Identification, distribution of data collection guides, gathering public information
Meeting #2	6/4/2008	Review of risk assessment, identification of plan goals and objectives, identification of key issues
Meeting #3	9/29/2008	Identification and evaluation of mitigation actions, action prioritization using STAPLEE, process for monitoring and updating the plan
Stakeholder Meetings	5/15/2008 – University of Kansas 9/2/2008 – Baker University and Baldwin City Commission 10/10/2008 – Baker University	Introduction to the DMA, the Planning Process, Goals and Objectives, Actions

Step 2: Plan for Public Involvement

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

At the initial kickoff meeting, attendees discussed methods that are routinely used to engage the public in Douglas County. Examples included e-mail to parents of students in the public school districts and informational notes included on local utility bills. Many members of the group also suggested the use of websites and newsletters.

During the drafting of the plan, HMPC members provided their constituents with information about the plan's progress including goals and objectives and the hazard ranking. A public input questionnaire was distributed by each HMPC member. A copy of the questionnaire is included as Appendix B. The results of the 37 responses are included below:

Of the hazards ranked as high by the HMPC, the following percentages of the respondents indicated that they had been personally affected by the hazard:

Extreme Temperature	Flood	Utility Failure	Wind Storm	Winter Storm	Tornado
27%	35%	30%	76%	43%	38%

A large percentage of the respondents (73%) felt that continued participation in the National Flood Insurance Program was “very important.” Each of the respondents also provided input into the types of projects/actions that they felt could benefit their community.

Acquisition of Flood Prone Properties	Additional Community Storm Shelters	Upgrades to the Electric Power System Infrastructure	Protection of Critical Facilities
65%	76%	49%	68%

The information derived from this public input was used to validate the committee decisions regarding hazard ranking and provide public input into the types of actions that were ultimately placed in this plan.

The public was also given an opportunity to provide input on a draft of the complete plan prior to its submittal to the State and FEMA. Douglas County provided the plan draft for review and comment on the Douglas County Emergency Management Agency website and in hard copy at the local public libraries. The plan was available at these locations from December 15, 2008, to December 29, 2008. The HMPC invited other targeted stakeholders to comment on the draft plan by e-mail or phone call. The list of stakeholders and e-mail message sent are provided in Appendix A.

Step 3: Coordinate with Other Departments and Agencies

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process. (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Involvement of Key Stakeholders

Key federal, state, and local stakeholders were involved from the beginning of the process. Federal FEMA officials were invited to each HMPC meeting and offered the opportunity to provide input. State agency representatives attended HMPC meetings and provided information as appropriate. For example, the Kansas Forestry Service provided information regarding specific hazards and suggested possible mitigation actions. The Kansas Department of Agriculture provided information regarding the National Flood Insurance Program. Local public health was also involved in the planning process. A representative of the USACE – Clinton Lake was also an active participant in the planning process.

Existing Plans, Studies, Reports, and Technical Information

At the second meeting of the HMPC, members reviewed GIS maps of the local area, including dams, bridges, utility infrastructure, and floodplain. Available local GIS information was subsequently obtained to provide the most accurate, up-to-date information. At the third meeting, HMPC members were presented information from the following relevant plans, studies, reports, and technical sources: Local Emergency Operations Plan, Flood Insurance Study, and Community Wildfire Hazard Assessment Report. Information regarding the current economic development plans was also discussed. Information from these plans and studies has been incorporated in the plan where appropriate.

1.2 Phase 2: Assess Hazards and Risk

Step 4: Identify the Hazards

AMEC assisted the HMPC in a process to identify the natural and technological hazards that have or could impact communities in Douglas County. The hazards identified in the State of Kansas Hazard Mitigation Plan were utilized as a starting point for identification of hazards that affect the Douglas County planning area. During the second meeting, the HMPC discussed each hazard identified in the State plan and came to consensus on which hazards to include in the Douglas County Multi-jurisdictional Hazard Mitigation Plan. More information on the methodology and resources used to identify and profile the hazards can be found in Chapter 3.

Step 5: Profile the Hazards

At the kick-off meeting, AMEC distributed data collection worksheets to be completed and returned by each member of the HMPC. This allowed for collection of information on historic hazard events that have impacted the planning area. In addition to the information provided by the HMPC, research was completed using the internet, existing reports and plans, and existing geographic information systems (GIS) layers to research past hazard events and determine the location, extent, magnitude, and future probability of all hazards identified in step 4 above. The individual hazard profiles can be found in Section 3.2

Step 6: Inventory Assets

Participating jurisdictions inventoried their assets at risk to natural hazards—overall and in identified hazard areas. The data collection worksheets distributed during the kick-off meeting also asked participating jurisdictions to inventory their specific assets. In addition, special stakeholder meetings were held with Colleges, Universities, and School Districts in Douglas County and with City officials to provide more specific information regarding the collection of appropriate risk and hazard data, and asset inventories. After profiling the hazards that could affect Douglas County, the HMPC collected information to describe the likely impacts of future

hazard events on the participating jurisdictions. This step included two parts: a vulnerability assessment and a capability assessment.

Vulnerability Assessment—Participating jurisdictions inventoried their assets at risk to natural hazards—overall and in identified hazard areas. These assets included total number and value of structures; critical facilities and infrastructure; natural, historic, and cultural assets; economic assets; and vulnerable populations. The HMPC also analyzed development trends in hazard areas. FEMA’s loss estimation computer software, HAZUS-MH, was used to estimate potential losses due to a 100-year flood in Douglas County streams that receive drainage from 10 square miles or more.

Capability Assessment—This assessment consisted of identifying the existing mitigation capabilities of participating jurisdictions. This involved collecting information about existing government programs, policies, regulations, ordinances, and plans that mitigate or could be used to mitigate risk to disasters. Participating jurisdictions collected information on their regulatory, personnel, fiscal, and technical capabilities, as well as ongoing initiatives related to interagency coordination and public outreach. This information is included in Chapter 3.

Step 7: Estimate Losses

Where sufficient information was available, a variety of methods was used to estimate losses for each profiled hazard that received a moderate or high planning significance level. For the flood hazard, FEMA’s loss estimation computer software, HAZUS-MH was utilized to estimate losses in the planning area as a result of a 100-year flood event. The methodology is described in detail for each hazard analysis that included a loss estimate. This information can be found in Section 3.3

Results of the risk assessment were presented and comments discussed at the second meeting of the HMPC on 6/4/2008.

1.3 Phase 3: Develop the Mitigation Plan

Step 8: Identify Goals and Objectives

Once the HMPC had completed the tasks of profiling hazards and estimating their potential losses, goals were developed. During the second meeting, the committee reviewed the results of the risk assessment, focusing on the key issues identified in Section 3.3.4 that focused on specific problems and trends and patterns identified through the review of previous hazard events. With the profiled hazards and their potential impacts in mind, the committee was divided randomly into small work groups of 5-8 persons and each group began a brainstorming session to identify the goals and objectives of the mitigation strategy for the planning area. Each group then presented their suggestions for goals and objectives that they felt would focus the mitigation strategy. After sharing ideas among the larger group, consensus was achieved on four goals.

Detailed information on these goals and the associated objectives that were selected to steer the committee toward appropriate mitigation actions can be found in Section 4.1.

Step 9: Develop Potential Mitigation Actions

During the Goals and Objectives meeting of the HMPC, committee members were provided with example mitigation actions and asked to complete mitigation project worksheets prior to the next meeting. Each committee member was encouraged to take the forms back to their constituents to discuss on-going mitigation projects and future needs. At the final HMPC meeting, participants reviewed all the proposed projects and held a discussion regarding additional projects that might benefit Douglas County. The potential projects were sorted into the appropriate goal and objective to assure that each was covered by appropriate mitigation actions. The group utilized the STAPLEE criteria to evaluate and rank each potential mitigation project. The evaluation tool focused on several questions. Does it reduce disaster damage? Does it contribute to other goals? Does it benefit the environment? Does it meet regulations? Will historic structures be saved or protected? Does it help achieve other community goals? Could it be implemented quickly? Using the scores from the rating systems, the projects were prioritized. Each participating jurisdiction provided at least one mitigation activity. There is at least one mitigation activity to support each goal and objective. The modified STAPLEE criteria form and a table showing the results of the STAPLEE analysis for each project can be found in Appendix C.

1.4 Phase 4: Evaluate the Work

Step 10: Draft the Mitigation Plan

A complete draft of the plan was made available in hard copy for review and comment by the public and other agencies and interested stakeholders on the Douglas County Emergency Management Agency website from 12/15/2008 to 12/29/2008. An additional copy of the plan was made available at the Lawrence Public Library. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3. Comments were integrated into a final draft for submittal to the Kansas Division of Emergency Management and FEMA Region VII.

Step 11: Adopt the Plan

To secure buy-in and officially implement the plan, the governing bodies of each participating jurisdiction adopted the plan. Scanned copies of resolutions of adoption are included in Appendix D.

Step 12: Implement and Maintain the Plan

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time during Meeting #3 on 9/29/2008. This strategy is described in Chapter 5.

CHAPTER 2 PLANNING AREA DESCRIPTIONS & CAPABILITIES

2.1 Douglas County Planning Area

History

Douglas County is located in northeast Kansas, in the Central United States. The County's population, one of the fastest-growing in the state of Kansas, was estimated to be 112,123 in the year 2006. Its county seat and most populous city is Lawrence, and the entire county is included in the Lawrence, Kansas, Metropolitan Statistical Area. Douglas County was opened for settlement on May 15, 1854, and was named for Stephen A. Douglas, a Senator from Illinois. The county was practically at the center of the Bleeding Kansas years as leaders in Lecompton, the territorial capital, wanted Kansas to be a slave state and leaders in Lawrence wanted Kansas to be a free state. Because of this, multiple events took place including the draft of the Lecompton Constitution, admitting Kansas to the Union as a slave state; the Sacking of Lawrence and the Battle of Black Jack.

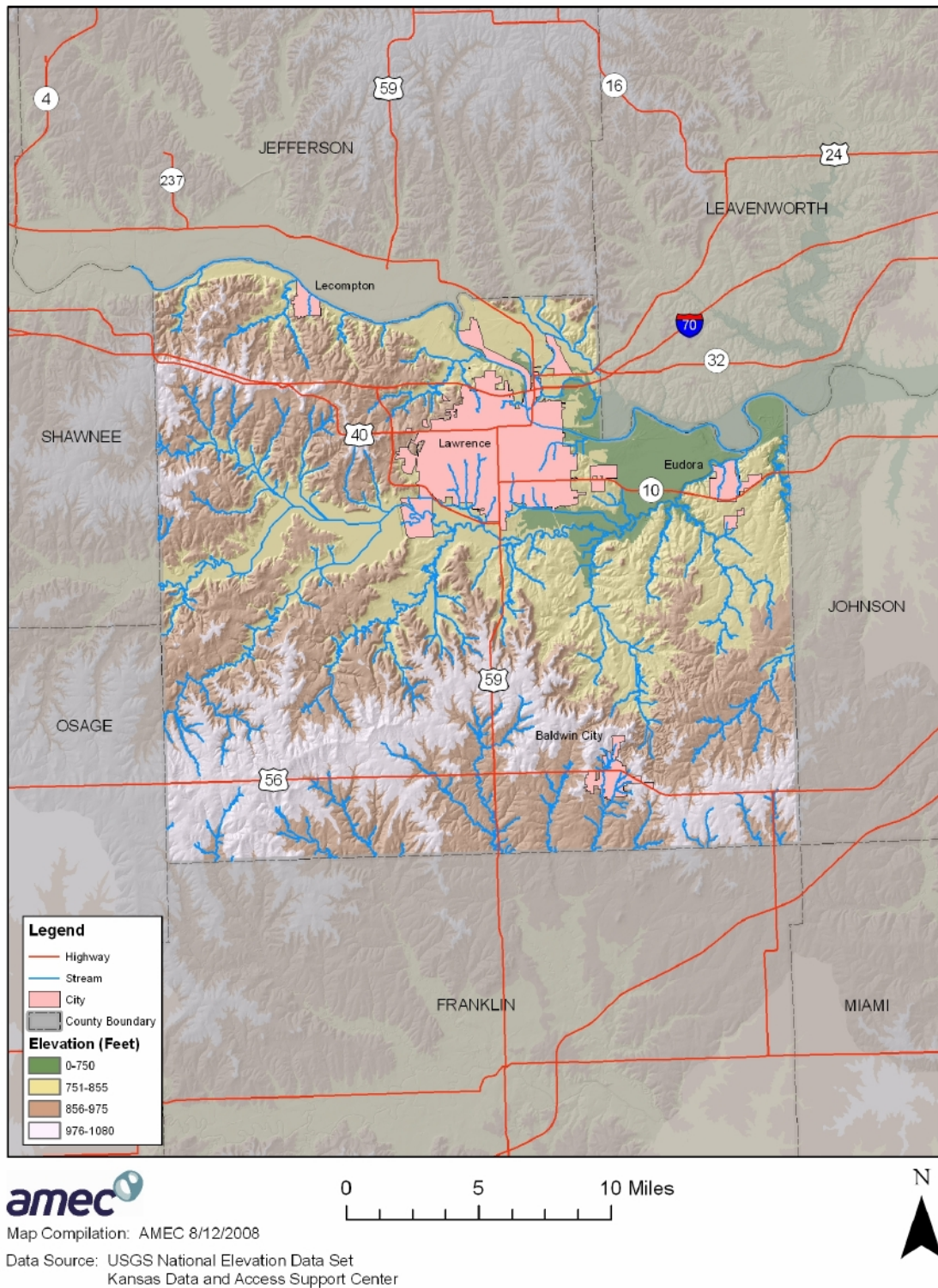
Geography

Douglas County is located in northeast Kansas. Neighboring counties are Johnson to the east, Shawnee and Osage to the west, Franklin to the south, and Jefferson and Leavenworth to the north. Figure 2.1 is a map of the Douglas County Planning Area.

Land area: 574 square miles

Water area: 1.2 square miles

Figure 2.1 Douglas County Planning Area

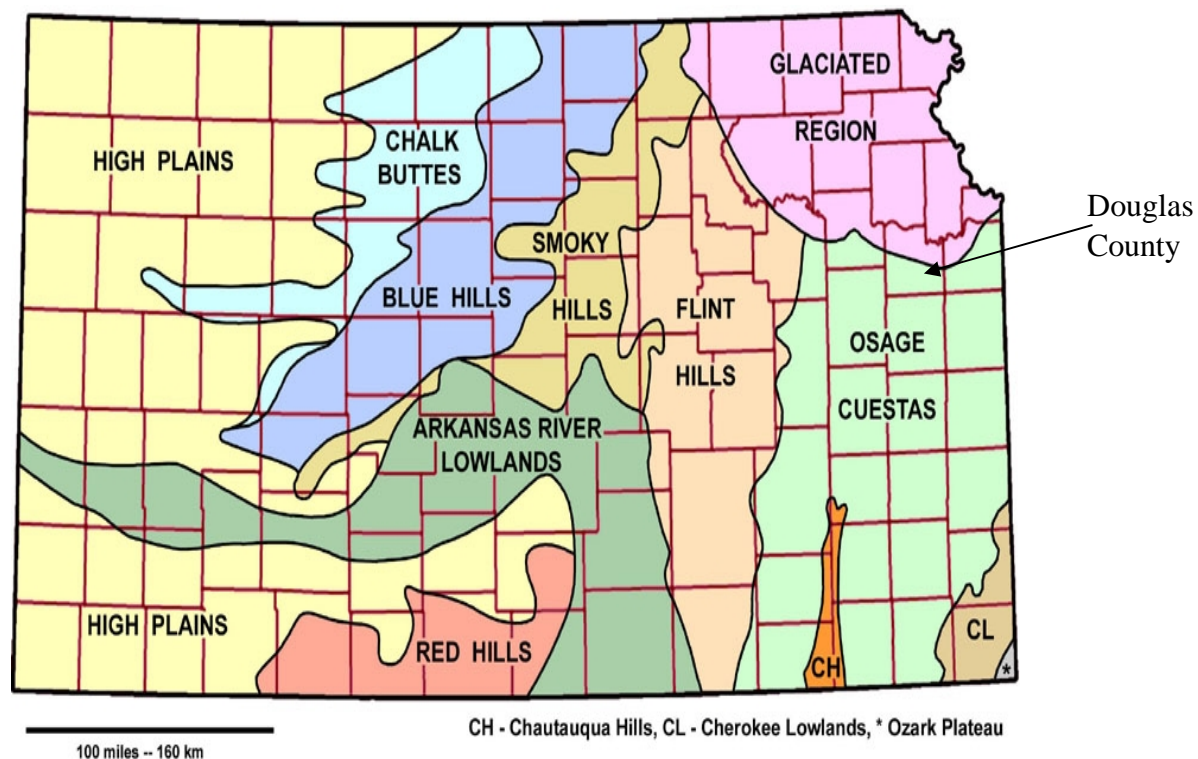


Topography

Kansas is divided into 13 distinct geographic regions. Each of these regions shows distinct landforms and topography. Each of these regions is also a direct reflection on the underlying geology. The rocks that make up these regions are oldest and lowest in elevation to the southeast, growing progressively higher and younger to the west.

The Osage Cuestas region of Kansas covers most of the southeastern portion of the state and extends far enough north to include the southern portion of Douglas County. The foundation rocks of the Osage Cuestas region are among the oldest exposed in Kansas. The Osage Cuestas are typified by rolling hills and low ridges that are steep on one side and gently sloping on the other. These landforms are known as cuestas. The northern portion of Douglas County is within the area defined as the Glaciated Region. Figure 2.2 shows the physiographic regions of Kansas.

Figure 2.2 Map Showing the Physiographic Regions of Kansas



Source: Image by J.S. Aber; <http://archaicgeo.angelfire.com>

Climate

Douglas County gets an average of 37.8 inches of rain per year. The US average is 37 inches. Snowfall averages 16.7 inches annually. The average US city gets 25 inches of snow per year. The average number of days per year with any measurable precipitation is 90.

On average, there are 212 sunny days per year in Douglas County, Kansas. The July high is 90 degrees. The January low is 20 degrees. The comfort index, which is based on humidity during the hot months, is 30 out of 100, where higher is more comfortable. The US average comfort index is 44. (Source: <http://www.bestplaces.net/County/Douglas-Kansas.aspx>).

Table 2.1 Climate Data for Douglas County

Climate	Douglas, KS	United States
Rainfall (in.)	37.8	36.6
Snowfall (in.)	16.7	25.2
Precipitation Days	93	101
Sunny Days	212	205
Avg. July High	90.4	86.5
Avg. Jan. Low	20.2	20.8
Comfort Index (higher=better)	30	44
UV Index	4.1	4.3
Elevation ft.	932	1,062

Source: <http://www.bestplaces.net/County/Douglas-Kansas.aspx>

Demographics/Population

According to the US Census Bureau, the 2006 population estimate for Douglas County was 112,123. This estimate includes the resident population including persons in Census described “group quarters.” This includes persons in school dormitories, long term care facilities, jails, etc., but would not include those students who commute to school. Approximately 87 percent of the population is urban and 13 percent is rural. The population density is classified as urban, with 219 people per square mile. The racial make-up of the county is 83.9 percent white, non-Hispanic, 4.1 percent black, 4.1 percent Asian, 2.3 percent American Indian, 3.8 percent Hispanic, and 2.4 percent combined races. (Totals do not equal 100 due to rounding.) The median resident age is 28.3 years old. This is in comparison to 35.2 years old for the State of Kansas. The county is 49.9 percent male and 50.1 percent female. (Source: US Census Bureau 2006 American Factfinder).

Table 2.2 Changes in Population and Housing Units

Location	1990 Population	2000 Population	2006 Population Estimate	Estimated Percent Change 1990-2006	1990 # of Housing Units	2000 # of Housing Units	Estimated Percent Change 1990-2000
Douglas County	81,798	99,962	112,123	37%	31,782	40,250	27%
Lawrence	65,608	80,098	88,605	35%	25,893	32,761	27%
Eudora	3,006	4,307	6,027	100%	1,136	1,664	46%
Lecompton	619	649	649	4%	221	233	5%
Baldwin City	2,961	3,400	4,145	40%	961	1,165	21%

(Source: US Census Bureau)

Economy/Industry

The total Douglas County labor force in 2004 was 63,455. This same year, the unemployment rate was 4.1 percent in the county. In September 2007 the unemployment rate dropped to 3.5 percent in the county. The estimated median household income in 2006 was \$48,857. This compares to \$48,451 for the United States.

In 2004, there were 2,742 business establishments in the county. Of those, 2,366 had 1-19 employees, 327 businesses had 20-99 employees, 45 had 100-499 employees and 4 businesses had 500 or more employees. Table 2.3 lists the major employers in Douglas County.

Table 2.3 Douglas County, Kansas, Major Employers

Employers	Product/Service	Full & Part-Time Employees
University of Kansas	Education	9,396
Pearson Government Solutions	Information Services	1,800
Lawrence Public Schools	Education	1,710
City of Lawrence	Government	1,250
Lawrence Memorial Hospital	Health Care	1,200
Hallmark Cards, Inc	Manufacturing	814
The World Company	Media	600
Baker University	Education	593
Amarr Garage Doors	Manufacturing	588
K-Mart Distribution	Retail Distribution	452

(Source: Institute for Policy and Social Research, University of Kansas, <http://www.ipsr.ku.edu/ksdata/kcced/profiles/index.shtml>)

Major Rivers and Watersheds

Lakes and reservoirs: The three major bodies of water in Douglas County include: Clinton Lake, Lone Star Lake, and Douglas County State Fishing Lake. Douglas County contains part of 4 watersheds: Lower Kansas, Lower Marais Des Cynges, Middle Kansas, and Upper Marais Des Cynges.

Streams, rivers, and creeks: Baldwin Creek, Coal Creek, Coon Creek, Kansas River, Little Wakarusa Creek, Naismith Creek, Quail Creek, Tauey Creek, Vinland Creek, Wakarusa River, Washington Creek, and Yankee Tank Creek. Numerous tributaries of these creeks exist within Douglas County and were studied as a part of the Flood Insurance Study conducted in 2001.

2.2 Jurisdictional Descriptions and Capabilities

Baldwin City

Baldwin City originally began as a trail stop on the Santa Fe Trail named Palmyra. The small town consisted of a harness shop, blacksmith, hotel, lawyer, drug store, post office, two doctors and a tavern. In 1858, a group of Methodist ministers gathered at Kibbee Cabin and founded Baker University. The town of Palmyra bought land to the south for the university and surrounding city. A main benefactor was John Baldwin and the town was named in his honor. Baldwin built a saw mill which was located at present-day Fifth and Indiana Streets. The City surrounds Baker University, which, founded in 1858, is the oldest four-year college in the state of Kansas. Four of Baker University's buildings are listed on the National Register of Historic Places. In addition to the historic buildings on the Baker University Campus and several historic sites located in the scenic countryside around Baldwin City, the City is also home to the historic, Nationally Registered 1906 Santa Fe Depot, the only remaining depot of Kansas' first railroad south of the Kansas River.

Baldwin City unwittingly found themselves surrounded by the events that led up to the Civil War. Three miles east of Baldwin was the town site of Black Jack where the Battle of Black Jack took place on June 2, 1856. The night before John Brown stayed in Prairie City and Quantrill's raiders passed within three miles of Baldwin after the burning of Lawrence in 1863.

Baldwin City is located at 38°46'39"N, 95°11'15"W (38.777597, -95.187418) The FIPS code for Baldwin City is 20-03900.

Land Use and Development Trends

Baldwin City has a comprehensive master plan that was adopted by the City in February 2008. The plan prepared by an engineering firm covers: Land Use, Neighborhood Preservation, Residential Development, Urban Area Reserve, Urban Growth, Commercial and Industrial Development, Transportation, Community Design and Character, and Parks and Open Space Preservation. According to the comprehensive plan, the Burlington Northern Santa Fe (BNSF) Intermodal facility at Gardner, Kansas, is an aspect that could influence growth for Baldwin City, and lead to demand for residential development. One of the features of the primary growth area of Baldwin City is the amount of land located in designated flood hazard zones associated with East Fork Tauey Creek, Middle Fork Tauey Creek, and Spring Creek. Approximately 590 acres of 100-year floodplain lies within the urban growth area. A challenge facing the planning of the primary growth area is to reduce flood damage to the built environment by managing urban development in the floodplain.

Technical and Fiscal Resources

Baldwin City is a small city with a limited number of full-time staff members. The city is able to contract for planners/engineers to manage land development and management issues. A public works director is responsible for oversight of construction practices. The Information Systems director is currently building skills for the City in GIS. Baldwin City has 42 full time employees on staff. The community does have access to capital improvements project funding, fees for city services, and has the authority to levy taxes for specific purposes. The city can incur debt through general obligation bonds, and special tax bonds and has the authority to withhold spending in special hazard prone areas.

Existing Plans and Policies

Baldwin City began participating in the National Flood Insurance Program via emergency entry in 1975 and converted to the regular program in 1980. In February 2008, Baldwin City passed a Comprehensive Plan that incorporated zoning ordinances, subdivision ordinances, growth management ordinances, and flood plain ordinances. The City utilizes the 2003 building code and its fire department has an ISO rating of 4. There is a storm water management ordinance and site plans are required to be reviewed by city officials. A local emergency operations plan also exists. Baldwin City, after recently completing the 2008 Comprehensive Plan, has now begun a process to update Zoning and Subdivision Regulations. The Code of the City of Baldwin City was updated in 2007 and is available on the City's website for citizen and stakeholder use and review. Baldwin City was included in the Flood Insurance Study completed for Douglas County.

Other Mitigation Activities

Baldwin City is proactive in undertaking mitigation projects. Currently, the city is involved in a program to place electric distribution lines underground in older areas of the city as upgrades to the city are completed. The electric substation is also protected by an earth berm as a flood control measure. Baldwin City is covered by outdoor warning sirens maintained by Douglas County. The community is a StormReady participant and the local fire and police departments regularly conduct public education activities related to hazard mitigation and emergency preparedness.

Eudora

Eudora is one of the mid-sized towns in Douglas County and is located in the northeastern part of the county on the south bank of the Kansas River and the Atchison, Topeka & Santa Fe R. R., 7 miles east of Lawrence. In 1856, three members of a German Immigrant Settlement Company (called Deutsche-Neusiedlungsverein) from Chicago, sent out a location committee to choose a town site in the new Indian Territory, which had been opened up to settlement by the Kansas-Nebraska Bill, passed in May 1854. Both pro-slavery and anti-slavery groups flocked to this territory. The three Germans sent to the present site were H. Heimann, F. Barteldes and C.

Scheifer. Favoring the Eudora area, they drew up contracts with Chief Paschal Fish for 774 1/2 acres, from the Kansas River to the south for about a mile (over 200 blocks total), with two public squares and a park. In February 1857, Chief Fish entered into contracts with the Trustees of the Chicago Verein for purchase of the land "to secure a more perfect title" at a price of \$10,000. Fish bought back on the same day the odd numbered lots of at least three blocks between the Kaw and Wakarusa rivers. A map of Douglas County drawn up in early 1857, before Eudora was a town, shows only four townships in the county with Eudora included in the Wakarusa township. The town's name was derived from the name of Chief Paschal Fish's 13-year old daughter; it is a name of Greek derivation meaning "giving" or "generous."

Eudora is located at 38°56'18"N, 95°5'51"W (38.938213, -95.097417). The FIPS Code is 20-21675.

Land Use and Development Trends

Eudora has an active Codes Department. Eudora is a part of the Lawrence Metropolitan Statistical Area and is an active growth area. Because of this growth, the school system has expanded its resources. In 2007 a \$45 million bond issue was approved to enhance the infrastructure of the district and support learning at all levels for students from pre-kindergarten through 12th grade. A FEMA safe-room project is included in the new construction.

Technical and Fiscal Resources

Eudora has EMS, fire and police departments with up-to-date equipment. The fire department has an ISO rating of 6. Other services such as a public library, Public Works department, Parks and Recreation department and sports complex are provided by the city. Eudora has a Mayor-Council form of government and the 2008 total adopted budget is \$12,785,039.

Existing Plans and Policies

Eudora began participating in the National Flood Insurance Program via emergency entry in 1975 and converted to the regular program in 1981. The community participates in the StormReady program.

Other Mitigation Activities

The City of Eudora received approval from FEMA for its hazard mitigation plan in 2008. The mitigation plan has a comprehensive range of mitigation activities designed to mitigate the identified hazards for Eudora. Those actions are for the most part included as a part of this plan. Upon approval and adoption of this multi-jurisdictional plan, the single jurisdiction plan for Eudora will be rescinded. As mentioned above, Eudora USD #491's FEMA storm shelter project at the new school construction is underway. Other projects currently underway include: distribution of NFIP information to homeowners in the floodplain and promotion of the use of all hazard weather radios. Douglas County maintains Eudora's outdoor warning sirens.

Lawrence

Lawrence is the sixth largest city in Kansas and the county seat of Douglas County. Located forty-one miles west of Kansas City, Missouri, it is situated along the banks of the Kansas and Wakarusa rivers. In 2007, the city had an estimated population of 89,852. Lawrence is a college town and is the home to the University of Kansas and Haskell Indian Nations University. Lawrence was founded in 1854 for the New England Emigrant Aid Company by Charles Robinson, who later served as governor of Kansas. The city was named after Amos Adams Lawrence, a prominent politician and antislavery partisan and the son of famed philanthropist Amos Lawrence. In the Bleeding Kansas era, Lawrence was a center of anti-slavery sentiment. On May 21, 1856, a pro-slavery posse led by Sheriff Samuel J. Jones burned the Free-State Hotel, destroyed the equipment of two anti-slavery newspapers, and looted several other businesses in an attack known as the Sack of Lawrence; one man was killed, struck dead by a stone falling from the burning hotel. Abolitionist John Brown's nearby Pottawatomie Massacre is believed to have been a reaction to this event. On August 21, 1863, during the American Civil War, Confederate guerrillas led by William Quantrill burned most of the houses and commercial buildings in Lawrence and killed 150 to 200 of the men they found in the Lawrence Massacre. Of historical importance is KU's Pioneer Cemetery, perhaps best known for being the final resting place of Thomas Barber, a free-state settler, and Elmer McCollum, KU alumnus who is credited with discovering Vitamin A. James Naismith, the inventor of basketball, is buried in East Lawrence in Memorial Park Cemetery.

Lawrence is situated at 38°57'36"N, 95°15'12"W (38.959902, -95.253199) The FIPS code is 20-38900.

Land Use and Development Trends

The City of Lawrence has an active Planning and Development Services department. The Planning and Development Services Department was established in 2008 by merging the Lawrence/Douglas County Planning Department and the Neighborhood Resources Department. The department is made up of four divisions. The Planning and Development Services division administers land use regulations and provides professional planning advice to the City and County governing bodies. The Code Enforcement division enforces building safety and environmental codes in the City. The Building Safety/Plan Review division conducts building inspections and reviews applications for building permits, licensees, etc. The Community Development Division administers the federal funding received by the City from HUD. The established Planning Commission is in the process of completing the five-year comprehensive plan update of the Horizon 2020 plan. As of January 2008, Chapters 1-6, 9, and 12 have been reviewed, updated, and amended. Chapters 7, 8, 10, 11 and 13 are currently being reviewed and updated. The Planning Commission's subcommittee responsible for reviewing and recommending Horizon 2020 updates is the Comprehensive Plans Committee. Future updates to Horizon 2020 will incorporate new information and chapters related to place making, environmental and natural resources, and community aesthetics and design. Currently there are

defined planning boundaries 1 & 2 and a nodal plan for 6th and K-10 West. The Planning Office is developing a sector plan for the area generally west of K-10 and south of Hwy. 40 containing approximately 2,065 acres with the input of property owners and stakeholders. Part of the planning area is east of K-10, south of Bob Billings Parkway to Clinton Parkway. This plan will help guide the city when making future land use decisions within the planning area when and if property is annexed into the city. The Planning Office has also begun the process of developing a sector plan for the area generally around the intersection of I-70 and K-10 and to the east approximately 4 miles and containing approximately 4,075 acres.

Technical and Fiscal Resources

The City of Lawrence is a fully-staffed jurisdiction with an annual operating budget topping \$148,000,000. It is organized into 12 departments to provide city services and enforce city policies. A full-time paid police department and fire/EMS department are available to the citizens. The fire department's ISO rating is 2 within the city limits of Lawrence. The public works department is the largest of the city departments. Lawrence has access to a long range planner who is responsible for floodplain management within the city boundaries. A GIS coordinator is also available and hazard areas within the jurisdiction have been mapped.

Existing Plans and Policies

Lawrence began participating in the National Flood Insurance Program via emergency entry in 1973 and converted to the regular program in 1981. The City of Lawrence has a master plan, comprehensive zoning ordinances and subdivision ordinances. A growth management program/ordinance is also a part of the Land Development Code. The City has site plan review requirements and a capital improvement plan. Emergency Management services and plans are the responsibility of Douglas County officials. The City of Lawrence is also a member of the Community Rating System.

Other Mitigation Activities

Lawrence is a member of the Community Rating System with a class 8 CRS rating and has a 10% insurance discount for special flood hazard areas and a 5% discount for non-special flood hazard areas. Each year they conduct outreach programs to all property owners in the floodplain including an informational mailing and distribution of a community wide floodplain brochure. The Douglas County website is comprehensive and provides citizens and homeowners with current information regarding hazards and hazard mitigation strategies currently in use in the jurisdiction. The Public Works department has a comprehensive plan for roadway maintenance and storm water system maintenance. Lawrence has an active recycling program and the City is active in pursuing environmentally friendly solutions when implementing mitigation programs. Douglas County covers the outdoor warning sirens for the City of Lawrence.

Lecompton

Lecompton, a town in Douglas County, is located on the Kansas River and the Atchison, Topeka & Santa Fe Railroad 11 miles west of Lawrence, the county seat. The first settlement on or near the town site was made in 1854. A considerable number of settlers came in 1855 and 1856. The Lecompton town company was organized at the Pottawatomie Indian agency with Samuel P. Lecompte, president; John A. Halderman, secretary; Daniel Woodson, treasurer; and George W. Clark, Chauncey B. Donaldson and William R. Simmons, members. The company held its meetings at Westport, Missouri, and on May 14, 1855, the officers reported that the town site, which consisted of 600 acres, had been surveyed by D. H. Harting with the design and intention of making Lecompton not only a large city but also the capital of the state. In 1855 the territorial legislature authorized the erection of a capitol building in the eastern part of the town on an eminence overlooking the Kansas valley on a tract of 10 acres donated by the town company. Had the building been completed according to the original design it would have cost \$500,000, provided Congress could have been induced to continue the appropriations. Lecompton was incorporated by the first territorial legislature with the following limits: "Commencing in the middle of the Kansas river, at a point which shall be designated by the surveyor now engaged in laying out and platting said town site; thence running in such manner as shall be designated by said surveyor throughout the entire limits of the town or city." Lecompton was made the county seat of Douglas county by the same legislature. The second and third sessions of the legislature met at Lecompton. During this period the town was at the height of its prosperity and gave promise of being one of the largest and most prosperous settlements in the territory. It was the seat of government, had a number of large hotels that were usually full; four church organizations; the United States land office; and was the headquarters for the stage line to Kansas City, Leavenworth and St. Joseph, Mo. It had a population of nearly 1,000 inhabitants and lots in the heart of the town sold at \$500 or more, but with the downfall of the slave power in the territory progress was arrested and within a short time her glory began to wane. When Topeka was made the capital it was a death blow to Lecompton and all her interests took a downward tendency. Dwelling houses were removed, some to the nearby towns, some to farms in the vicinity, others fell to pieces, weeds grew in the once busy streets; work upon all public buildings ceased and the ruins were left to stand as ghastly reminders of the blasted hopes that had been so high. The population rapidly diminished to about 300 and remained at that figure for a number of years.

Lecompton is located at 39°2'35"N, 95°23'42"W (39.042927, -95.395039). The FIPS code is 20-39150.

Land Use and Development Trends

The City of Lecompton adopted a Community Comprehensive Plan in 2003, which covers a 3 mile rural area related to commercial and residential development.

Technical and Fiscal Resources

Lecompton is a small city and does not maintain a large full-time city staff. Lecompton utilizes Douglas County officials for most highly specialized technical needs such as law enforcement,

GIS, land development, and land management practices. The city does have a grant writer on staff. The City has access to Community Development Block Grants, capital improvement project funding and collects fees for services. Lecompton can incur debt through general obligation bonds and through special tax bonds. They also have the authority to collect impact fees for new development and to withhold spending in hazard prone areas. Lecompton can also levy special taxes for specific purposes.

Existing Plans and Policies

Lecompton began participating in the National Flood Insurance Program via emergency entry in 1975 and converted to the regular program in 1979. The Community Comprehensive Plan, adopted in 2003, provides a zoning ordinance, subdivision ordinances, and growth management ordinances. There is also a flood plain ordinance in effect in Lecompton. The city has a water drought/emergency ordinance and requires site plans to be reviewed. The city's fire department has an ISO rating of 7. An economic development plan is also available. Lecompton is currently working towards the goal of a capital improvement plan.

Other Mitigation Activities

Lecompton is covered by outdoor warning sirens that are maintained by Douglas County. The city has a long-range plan for reduction of congestion of traffic by establishing collector streets. The community offered Community Emergency Response Team (CERT) training for citizens.

Unincorporated Douglas County

Unincorporated Douglas County consists of 9 townships: Clinton, Eudora, Grant, Kanwaka, Lecompton, Marion, Palmyra, Wakarusa, and Willow Springs. Officials from Clinton, Lecompton, and Wakarusa townships participated in this planning effort. Therefore information is included in this section for those townships. Information regarding assets of the participating townships is included in Chapter 3.

Land Use and Development Trends

The County has been a part of the Horizon 2020 planning development process utilized by the City of Lawrence. Planning and development of unincorporated areas is taken into consideration by these plans. Plans for development are structured and vetted through the public and landowners/stakeholders. Currently there are defined plan boundaries 1 & 2 and a nodal plan for 6th and K-10 West. The Planning Office is developing a sector plan for the area generally west of K-10 and south of Hwy. 40 containing approximately 2,065 acres with the input of property owners and stakeholders. Part of the planning area is east of K-10, south of Bob Billings Parkway to Clinton Parkway. This plan will help guide the city when making future land use decisions within the planning area when and if property is annexed into the city. The Planning Office has also begun the process of developing a sector plan for the area generally around the intersection of I-70 and K-10 and to the east approximately 4 miles and containing

approximately 4,075 acres. Significant growth within Douglas County is expected within the next 10 years.

Technical and Fiscal Resources

Douglas County has access to many full-time technical personnel. A full-time GIS official and full-time emergency management staff is available. The Zoning and Codes department has full-time engineering staff devoted to construction practices, land development and land management practices. GIS data is available for critical facilities, land use, and building footprints. The GIS data is linked to the County Appraiser's office data. Douglas County has access to Community Development Block Grants, capital improvement project funding, and has the authority to levy taxes for specific purposes and to incur debt through general obligation bonds. The County also collects fees for services it provides.

Existing Plans and Policies

Douglas County began participating in the National Flood Insurance Program via emergency entry in 1975 and converted to the regular program in 1981. Douglas County has zoning ordinances, subdivision ordinances, a flood plain ordinance and site plan review requirements. The fire department has an ISO rating of 2 within the city limits of Lawrence, and a rating of 9/10 outside the city limits. A capital improvements plan exists. The Douglas County Emergency Management Agency maintains a comprehensive emergency management plan that is utilized by all cities within the county and the unincorporated areas.

Other Mitigation Activities

Douglas County is equipped with outdoor warning sirens. Douglas County is a StormReady community. The local emergency management agency maintains a comprehensive website with information regarding hazard mitigation and emergency preparedness for the public. An Emergency Preparedness Handbook is available in print or on-line. Fire safety, household preparedness and environmental education are all addressed in the handbook.

Lecompton Township

Lecompton Township has a fire department with fire stations in Lecompton, Big Springs, and on Farmers Turnpike near the Lecompton exit on I-70. They have 8 fire trucks. The fire department has an ISO rating of 7/9. The township relies largely on Douglas County for its technical resources and any needed technical personnel such as engineers and GIS.

Wakarusa Township

Wakarusa Township has a fire department. The township relies largely on Douglas County for its technical resources and specialized personnel such as GIS specialists. The township areas are subject to the Douglas County floodplain ordinance. Wakarusa Township conducts numerous

public education activities. The township fire department assists state fire officials with walk through inspections of facilities in the jurisdiction and they also sponsor a fire prevention booth at the county fair each year. The fire department has two fire stations and seven fire trucks.

Clinton Township

Clinton Township has a fire department and also contains a water treatment plant. The fire department has an ISO rating of 9 and potential chlorine spills are of concern to township officials. The township relies largely on Douglas County for its technical resources and specialized personnel, such as GIS specialists. The township areas are subject to the Douglas County floodplain ordinance.

Douglas County Rural Water Districts

Douglas County is comprised of six (6) rural water districts (RWD) numbered 1 through 6. Of the 6 RWDs, three participated in the mitigation planning effort and submitted information on the data collection forms. This information is summarized below in Table 2.4:

Table 2.4 Rural Water District Capabilities

Water District	Regulatory Tools	Personnel Resources	Fiscal Assets	Public Education / Mitigation Activities
RWD #2	Emergency water supply plan, mutual aid agreements, water rationing	Emergency manager	Fees for water	Accidental spill or contamination plan
RWD #5	Emergency water supply plan, water conservation plan, drought contingency plan	Planner / engineer	Capital Improvement funds, fees for water, impact fees for new development	Warning systems at tower level, routine water sample testing, annual newsletter
RWD #6	Capital improvements plan, emergency water supply plan, water rationing ordinance, mutual aid agreements	Through Douglas County only	Capital Improvement funds, fees for water, ability to incur debt through private activities and ability to withhold spending in hazard prone areas	None

Douglas County School Districts

There are five (5) Unified School Districts (USDs) that serve Douglas County. They include USD #289 serving Wellsville, USD #343 serving Perry-Lecompton, USD #348 serving Baldwin City, USD #491 serving Eudora, and USD #497 serving Lawrence. Four of the school districts

chose to participate in this multi-jurisdictional hazard mitigation plan and provided additional data. Information on capabilities within the school districts is provided below in Table 2.5:

Table 2.5 School District Capabilities

School District	Regulatory Tools	Public Safety on Site	Financial Resources	Education and Mitigation Activities
USD 343	Emergency operations plan, full time building official, weapons policy	No	Capital Improvements, State taxes, Authority to levy local taxes/bonds	Routine fire, tornado and intruder drills
USD 348	Weapons policy, full time building official, plans for evacuation of special needs students, 10 year building plan, school emergency plan	No	Capital Improvements, State taxes, Authority to levy local taxes/bonds	Routine fire, tornado and evacuation drills
USD 491	Weapons policy, full time building official, plans for evacuation	No	Capital Improvements, State taxes, Authority to levy local taxes/bonds	Routine fire, tornado and evacuation drills, mental health crisis team, emergency phone broadcast (schoolreach), 2007 safe room for new construction
USD 497	Master plan, capital improvement plan, school emergency plan, weapons policy, evacuation protocol, communicable disease plan, full-time building officials, emergency manager, and public information officer	No	Capital Improvements, State taxes, Authority to levy local taxes/bonds	Routine fire, tornado and evacuation drills, safe schools audit at the beginning of each year, security systems upgrades in 2008, emergency notification system, emergency generators

Douglas County Colleges and Universities

The University of Kansas and Baker University both have campuses within Douglas County.

University of Kansas

Opened in 1866, the University of Kansas (KU) is a comprehensive educational and research institution with 29,260 total enrollments (20,298 undergraduates and 6,044 graduate students) at the Lawrence and Edwards campuses and more than 2,100 faculty members. Considered one of the most beautiful campuses in the nation, KU's main campus occupies 1,000 acres on and around Mount Oread in Lawrence. Students are able to complete degrees in more than 170 fields of study. Research is also an integral part of the university's educational activity. KU's total research expenditures in fiscal year 2005 for all projects, including sponsored research, training and service grants in all fields, were \$281 million, a 3 percent increase over 2004. KU's total

research expenditures funded from grants and contracts reached \$187.6 million in 2005. The University has three child development centers.

Development Trends

The University of Kansas has an active capital improvements plan. Projects are managed using state general funds, private gifts, bonds, tuition, etc. Major developments are planned for research facilities such as the addition to the School of Pharmacy. The initial phase of the addition will include 110,000 gross square feet including a model pharmacy, integrated instructional labs, library and computer commons, lecture and teaching labs. Additional projects include a \$116,000,000 undergraduate science facility, a \$175,000,000 cancer research center including the construction of a state of the art vivarium.

Technical and Fiscal Resources

The University has access to many technical resources including planners/ engineers trained in construction practices and building infrastructure. Landscape architects and design construction management professionals are also on staff at KU. The division of Facilities Operations has full-time building officials including a University Fire Marshal. The Public Safety Office has full-time staff of 52. The University has access to GIS services and is in the process of converting identified hazard areas, critical facilities, and building footprints into GIS format. A campus-wide warning system is in place, but is being enhanced with additional electronic mechanisms for notification. KU has access to state general fund dollars and state bond funds. Revenues are collected from parking and other fees, tuition, and housing fees. The University receives a number of federal grants and also is the recipient of many private gifts.

Existing Plans and Policies

KU has a well-developed Emergency Operations Plan and has recently hired a full-time emergency manager. There is a Master Plan for the Lawrence Campus and a five year Capital Improvement Plan that is submitted to and reviewed by the Kansas Board of Regents each year. The University also has in place a weapons policy, evacuation protocols, shelter-in-place protocols, site security protocols and a communicable disease plan.

Other Mitigation Activities

The University has outdoor warning sirens that are maintained by Douglas County. They conduct regular drills and exercises related to emergency preparedness. Each student is given an orientation to safety protocols and procedures for severe weather and other hazards at the beginning of the school year. At the new child development center, there are 4 tornado safe rooms. The center is currently undergoing an addition in which an additional safe room will be added. KU has an extensive grounds keeping program that takes hazard mitigation techniques such as tree trimming into account on campus areas.

Baker University

Baker University, founded in 1858, is the oldest four year college in Kansas. The university's main campus is located in Baldwin City. The Baldwin City campus, which serves College of Arts and Science students and School of Education undergraduates, reported an enrollment of 998 students, the highest figure for that location in at least 30 years. The enrollment figure includes non-degree seeking students. The on-campus population totals 947 students.

Development Trends

Baker University has an active Capital Improvements program. With the passing of a recent bond issue for the local school district, the University has the opportunity to potentially develop land connected to the main Baldwin Campus. A project which will restore and expand the Baker Wetlands is also underway.

Technical and Fiscal Resources

A full time emergency manager and full time building official are on University staff. A grant writer as well as a dedicated public information officer is also available to the University. No on-site police or fire department is available, and the University relies on local Baldwin City resources for these services. The Chief Financial Officer serves as the risk management official for the campus. Baker University has a large endowment and utilizes other private donations. They do have projects that have been funded through general obligation bonds.

Existing Plans and Policies

The University has several existing emergency plans including shelter-in-place protocols, a weapons policy, evacuation plans, site security protocols, special event emergency plans, and a communicable disease plan. The University does have maps of its critical facilities and a maximum occupancy policy.

Other Mitigation Activities

The University conducts regular drills and exercises related to emergency preparedness. Each student is given an orientation to safety protocols and procedures for severe weather and other hazards at the beginning of the school year.

Baker University has also begun restoring and expanding the Baker Wetlands at a 142-acre site west of Louisiana Street between 31st and the Wakarusa River. The restoration project is being funded by the Kansas Department of Transportation (KDOT) using the remainder of a \$1.5 million federal appropriation received in 2005. KDOT recently provided Baker University funds to cover equipment costs, construction of trails, a boardwalk and signage and a manager's salary to begin the restoration project. Baker has received \$415,000 of the \$975,000 in funding to complete Phase I of the wetlands restoration project.

Table 2.6 summarizes existing mitigation-related plans and policies in Douglas County and participating incorporated cities:

Table 2.6 Summary of Existing Mitigation-Related Plans and Policies in Douglas County

Capability	Douglas County	Lawrence	Eudora	Lecompton	Baldwin City
Master/Comprehensive Plan	Y	Y	Y	Y	Y
Emergency Operations Plan	Y			Y	Y
Economic Development Plan	Y	Y		Y	
Capital Improvements Plan	Y	Y	Y		Y
Building Code	Y	Y	Y	Y	Y
Building Code Year	1997	2006	1994	2003	2003
Fire Department ISO Rating	9 /10 outside city limits	2	6	7	4
Storm water Management Ordinance					Y
Floodplain Management Ordinance	Y	Y	Y	Y	Y
Zoning Ordinance	Y	Y	Y	Y	Y
Subdivision Ordinance	Y	Y	Y	Y	Y
Erosion Management Ordinance					Y
National Flood Insurance Program Participant	Y	Y	Y	Y	Y
Flood Insurance Rate Map Last Delineation Date	1981	1981	1981	1979	1980
Elevation Certificates Maintained		Y			

3 RISK ASSESSMENT

44 CFR Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Risk to natural hazards is a combination of hazard, vulnerability, and capability. This chapter examines hazards and vulnerability. Jurisdictional annexes to the plan discuss the capabilities for each of the participating jurisdictions as well as the hazards and vulnerability particular to their area.

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The goal of the risk assessment is to estimate the potential loss in Douglas County, including loss of life, personal injury, property damage, and economic loss, from a hazard event. The risk assessment process allows communities in Douglas County to better understand their potential risk to natural hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

The risk assessment for Douglas County and its jurisdictions followed the methodology described in the FEMA publication 386-2, *Understanding Your Risks: Identifying Hazards and Estimating Losses* (2002), which includes a four-step process:

- Identify Hazards
- Profile Hazard Events
- Inventory Assets
- Estimate Losses

This chapter is divided into three parts: hazard identification, hazard profiles, and vulnerability assessment:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.
- **Section 3.2 Hazard Profiles** discusses the threat to the planning area and describes previous occurrences of hazard events and the probability of future occurrence.
- **Section 3.3 Vulnerability Assessment** assesses the County's total exposure to natural hazards, considering critical facilities and other community assets at risk, and assessing growth and development trends. Hazards that vary geographically across the planning area are addressed in greater detail. This section includes steps 3 and 4 from above.

3.1 Hazard Identification

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type of all natural hazards that can affect the jurisdiction.

3.1.1 Methodology

The Hazard Mitigation Planning Committee (HMPC) reviewed hazard specific data from a variety of sources, and discussed the impacts of each of the hazards required by FEMA for consideration, which are listed alphabetically below:

Avalanche	Hurricane
Coastal Erosion	Land Subsidence
Coastal Storm	Landslide
Dam/Levee Failure	Severe Winter Storm
Drought	Tornado
Earthquake	Tsunami
Expansive Soils	Volcano
Extreme Heat	Wildfire
Flood	Windstorm
Hailstorm	

In addition to reviewing hazards required by FEMA for consideration, the HMPC also considered the following hazards profiled in the State of Kansas Hazard Mitigation Plan:

- Agricultural Infestation
- Fog
- Lightning
- Major Disease Outbreak
- Soil Erosion & Dust
- Utility/Infrastructure Failure

Data on the past impacts and future probability of these hazards in the Douglas County planning area was collected from the following sources:

- Kansas Hazard Mitigation Plan (November 2007)
- Information on past extreme weather and climate events from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center
- Federal Disaster Declarations from the Federal Emergency Management Agency (FEMA)
- USDA Farm Service Agency Disaster Declarations
- Various articles and publications available on the internet (sources are indicated where data is cited) and information obtained from HMPC members and their constituents.

The HMPC eliminated some hazards from further profiling because they do not occur in the planning area or their impacts were not considered significant in relation to other hazards. Table 3.1 lists these hazards and provides a brief explanation for their elimination.

Table 3.1 Hazards Not Profiled in the Plan

Hazard	Explanation for Omission
Avalanche	There are no mountains in the planning area.
Coastal Erosion	Planning area is not near coastal areas.
Coastal Storm	Planning area is not near coastal areas.
Hurricane	Planning area is not near coastal areas.
Major Disease Outbreak	The local health department maintains a plan on Major Disease Outbreak
Tsunami	Planning area is not near coastal areas.
Volcano	There are no volcanic mountains in the planning area.

The HMPC identified 18 hazards that significantly affect the planning area and organized these hazards to be consistent with the Kansas Hazard Mitigation Plan (November 2007). These hazards are listed below and profiled in further detail in the next section. All other man-made hazards are addressed in the Douglas County Emergency Operations Plan and appropriate annexes. Table 3.2 lists the 18 hazards that are addressed by the plan and indicates the hazards identified for the unincorporated county as well as each incorporated city. This analysis method ensures that all of the land area in the planning area is considered. For the school districts, colleges, and other special districts, their boundaries, assets, and facilities overlap city and county boundaries. To determine the hazards that impact specific assets within these other jurisdictional boundaries, refer to the county or city in which the assets are located. For the Wildfire hazard identification, the hazard was considered to be present only for those areas that received a moderate or high risk rating in the Douglas County Community Wildfire Assessment Report prepared by the Kansas Forest Service discussed in detail in Section 3.2.17.

Table 3.2 Hazards Addressed in the Douglas County Hazard Mitigation Plan

Hazard	Douglas County	Baldwin City	Eudora	Lawrence	Lecompton
Agricultural Infestation	X	X	X	X	X
Dam and Levee Failure	X			X	
Drought	X	X	X	X	X
Earthquake	X	X	X	X	X
Expansive Soils	X	X	X	X	X
Extreme Temperatures	X	X	X	X	X
Flood	X	X	X	X	X
Fog	X	X	X	X	X
Hailstorm	X	X	X	X	X
Land Subsidence	X	X	X	X	X
Landslide	X	X	X	X	X
Lightning	X	X	X	X	X
Soil Erosion and Dust	X	X	X	X	X
Tornado	X	X	X	X	X
Utility/Infrastructure Failure	X	X	X	X	X
Wildfire	X	X			
Windstorm	X	X	X	X	X
Winter Storm	X	X	X	X	X

3.1.2 Disaster Declaration History

One method used by the HMPC to identify hazards was to examine events that triggered federal and/or state disaster declarations. Federal and/or state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

A USDA disaster declaration certifies that the affected county has suffered at least a 30 percent loss in one or more crop or livestock areas and provides affected producers with access to low-interest loans and other programs to help mitigate the impact of the disaster. In accordance with the Consolidated Farm and Rural Development Act, all counties neighboring those receiving disaster declarations are named as contiguous disaster counties and, as such, are eligible for the same assistance.

Table 3.3 lists USDA and federal disaster declarations received by Douglas County. Many of the disaster events were regional or statewide; therefore, reported costs are not accurate reflections of losses to Douglas County. USDA Declarations are reported for the period of 2005-2007 only.

Table 3.3 Disaster Declaration History in Douglas County, 1967-Present

Declaration Number	Declaration Date	Disaster Description	Counties Involved	Constant 2006
Major Disaster Declarations				
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
1638	4/14/2006 (3/12-13/2006)	Severe Storms, Tornadoes, and Straight-Line Winds	Douglas , Wyandotte	n/a
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
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

Declaration Number	Declaration Date	Disaster Description	Counties Involved	Constant 2006
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
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 (10/1-10/8/1998)	Severe Storms, Flooding, and Tornadoes	Bourbon, Cherokee, Douglas , Franklin, Jackson, Jefferson, Johnson, Leavenworth, Linn, Seward, Wabaunsee, Wyandotte	11,814,290
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
644	7/18/1981	Severe Storms, Flooding, Tornadoes	Barton, Douglas	1,451,391
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

Declaration Number	Declaration Date	Disaster Description	Counties Involved	Constant 2006
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, Wabaunsee, Washington, Woodson, Wyandotte	8,829,200
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
Emergency Declarations				
3236	9/10/2005	Hurricane Katrina Evacuation	All	0
3282	12/12/2007	Severe Winter Storms	All	0
USDA Declarations (for Douglas County)				
M1711	6/26/2007	Severe Storms, Excessive Moisture	Including Douglas County	n/a
M1699	5/4/2007	Tornadoes, Severe Storms, Excessive Moisture	Including Douglas County	n/a
S2525	4/4/2007	Excessive Heat, Winter Storms	Including Douglas County	n/a
S2485	1/1/2006	Drought, Excessive Heat, High Winds	Including Douglas County	n/a
M1638	3/12/2006	Tornadoes, Severe Storms, High Winds	Including Douglas County	n/a
S2128	1/1/2005	Drought, High Winds, Excessive Heat, Winter Storms	Including Douglas County	n/a

Declaration Number	Declaration Date	Disaster Description	Counties Involved	Constant 2006
M1579	1/4/2005	Winter Storms, Excessive Moisture	Including Douglas County	n/a
M1615	10/1/2005	Severe Storms, Excessive Moisture	Including Douglas County	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

3.2 Hazard Profiles

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

3.2.1 Methodology

Each hazard identified in Section 3.1 Hazard Identification is profiled individually in this section. The level of information presented in the profiles varies by hazard based on the information available. With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards that affect Douglas County.

The sources used to collect information for these profiles include those mentioned in Section 3.1.1 as well as those cited individually in each hazard section. This plan includes detailed profiles for each of the identified hazards which are categorized into sections, as shown below.

Hazard Description

A Hazard Description is a general description of the hazard and the type of impact it may have on a community. It includes a ranking to indicate typical warning times and duration of hazard events. Definitions for these rankings are included in Table 3.4.

Geographic Location

This section offers a description of the geographic extent or location of the hazard in the planning area. Where available, maps are utilized to indicate the areas of the planning area that are vulnerable to the subject hazard.

Previous Occurrences

Information on historic incidents and their impacts based upon the sources described in Section 3.1 Hazard Identification, and the information provided by the HMPC.

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. Where possible, the probability or chance of occurrence was calculated based on historical data. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. However, due to general inconsistencies in local event reporting to the National Climatic Data Center, the final probability was determined by the HMPC based on local data and their expertise and familiarity with the planning area.

Magnitude/Severity

The magnitude of the impact of a hazard event (past and perceived) is related directly to the vulnerability of the people, property, and the environment it affects. This is a function of when the event occurs, the location impacted, the resilience of the community, and the effectiveness of the overall emergency response and disaster recovery efforts.

Hazard Summary

In compliance with the requirement by the Kansas Division of Emergency Management the HMPC used the methodology from the MitigationPlan.com planning tool to prioritize the hazards. This prioritization was based on a Calculated Priority Risk Index (CPRI) that considers four elements of risk: probability, magnitude/severity, warning time, and duration. Table 3.4 defines the rankings for each element of risk.

Table 3.4 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 Occasional	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 percent 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 percent 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 percent 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 percent 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

Source: MitigationPlan.com

The formula to determine each hazard's CPRI, which includes weighting factors defined by MitigationPlan.com, is:

$$(\text{Probability} \times .45) + (\text{Magnitude/Severity} \times .30) + (\text{Warning Time} \times .15) + (\text{Duration} \times .10) = \text{CPRI}$$

Based on their CPRI, the hazards were separated into three categories of planning significance: High (3.0-4.0), Moderate (2.0-2.9), and Low (1.1-1.9).

These terms relate to the level of planning analysis for each hazard considered 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 high or moderate significance 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.

Table 3.5 summarizes the results of the completed Hazard Profile Section using this methodology:

Table 3.5 Hazard Profile Summary for Douglas County with Calculated Priority Risk Index (CPRI)

Hazard Type	Probability	Magnitude	Warning Time	Duration	CPRI	Planning Significance
Agricultural Infestation	2	2	1	4	2.05	Moderate
Dam and Levee Failure	1	4	2	4	2.35	Moderate
Drought	3	2	1	4	2.50	Moderate
Earthquake	1	2	4	1	1.75	Low
Expansive Soils	3	2	1	4	2.50	Moderate
Extreme Temperatures	4	3	1	4	3.25	High
Flood	4	3	3	4	3.55	High
Fog	4	2	2	1	2.80	Moderate
Hailstorm	4	2	4	1	3.10	High
Land Subsidence	1	1	4	4	1.75	Low
Landslide	1	1	3	1	1.30	Low
Lightning	4	2	2	1	2.80	Moderate
Soil Erosion & Dust	1	2	1	4	1.60	Low
Tornado	3	4	4	1	3.25	High
Utility / Infrastructure Failure	4	3	4	4	3.70	High
Wildfire	3	2	4	3	2.85	Moderate
Windstorm	4	3	4	2	3.50	High
Winter Storm	4	3	2	4	3.40	High

The Probability, Magnitude, Warning Time, and Duration levels were determined by the Douglas County HMPC.

3.2.2 Agricultural Infestation

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. The Kansas Department of Agriculture currently has 15 plant diseases and pests on a “high priority watch list” and provides periodic monitoring and reporting of insect species for field crops, orchards, and nurseries. 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.

Warning Time: Level 1 24 hours

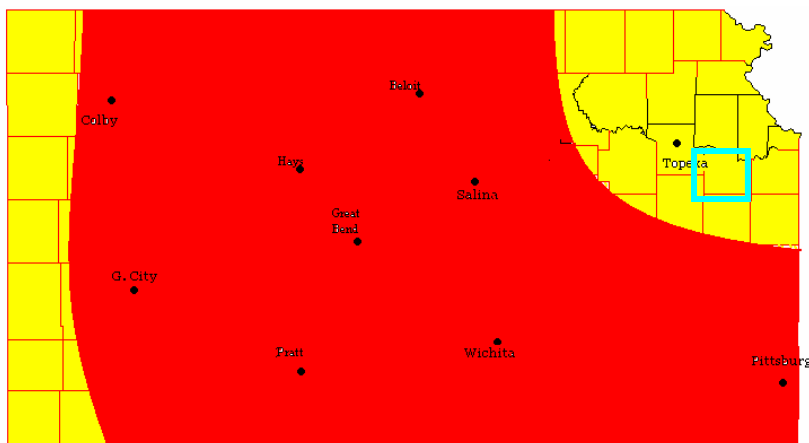
Duration: Level 4 More than 1 week

Geographic Location

According to the Kansas Agricultural Statistics Service, 202,000 acres are classified as farm land in Douglas County, representing 67 percent of the total planning area. All agricultural areas are subject to agricultural infestations, though a major infestation event would affect the entire county including urbanized areas either directly or indirectly.

The western and northeastern parts of the state of Kansas were somewhat less susceptible to leaf rust in 2007, a common disease affecting wheat crops. This geographic distribution for leaf rust corresponds with areas of the state with somewhat lower utilization of the land for crops and rangeland, and fewer feedlots. Figure 3.1 shows areas of moderate (yellow) and severe (red) leaf rust disease pressure in 2007.

Figure 3.1 Leaf Rust Disease Pressure, Kansas 2007



Source: Kansas State Department of Agriculture, Kansas Cooperative Plant Disease Survey Report: Preliminary 2007 Kansas Wheat Disease Loss Estimates, www.ksda.gov/plant_protection/content/183/cid/611

Notes: Red = High to Severe, Yellow = Moderate. Blue box indicates approximate location of Douglas County

Previous Occurrences

Significant wheat crop losses due to these diseases are well documented in various areas of Kansas. In 2006 approximately 5,000 acres of wheat were harvested in Douglas County. Sorghum losses can occur when a crop is infected with sooty stripe early in the growing season. In 2006 approximately 500 acres of sorghum were harvested, and 24,700 acres of corn were harvested. Gray leaf spot is a growing problem for corn crops. Infestation is not only a risk to crops in the field. Insect infestation can 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.

Statewide cumulative disease losses for the 2007 wheat crop were estimated at 17.8 percent of the crop (65.1 million bushels). This estimate exceeds the 20 year average of 11.4 percent loss and is the greatest cumulative loss since 1995 when foliar diseases and barley yellow dwarf virus were the primary contributors to a 20.4 percent loss. In 2007, leaf rust, which was epidemic statewide, made up about 80 percent of the total disease loss estimate. The *Septoria* leaf disease complex was responsible for 1.8 percent of the loss followed by tan spot with 1.3 percent. Barley yellow dwarf, stripe rust, scab, and powdery mildew had estimates of 0.2 percent each and were occasionally found at significant levels. Table 3.6 shows rankings for 2007 wheat losses in Kansas.

Table 3.6 Rankings for 2007 Wheat Losses and Comparisons (percent of yield)

Disease	2007	2006	20-Year Average
Leaf Rust	13.9	0.1	3.79
<i>Septoria</i> Complex	1.8	0.001	0.97
Tan Spot	1.3	0.2	0.96
Powdery Mildew	0.2	0.1	0.22
Barley Yellow Dwarf	0.2	0.8	1.21
Scab	0.2	0.001	0.21
Stripe Rust	0.2	0.001	1.31
Bunt And Loose Smut	0.02	0.05	0.01
Soil Borne Mosaic And Spindle Streak Complex	0.01	0.05	0.37
Wheat Streak Complex	0.01	7	1.94
Snow Mold	0.01	0	0.00
Root And Crown Rots	0.01	0.1	0.13
Take All	0.001	0.1	0.24
Bacterial Leaf Blight	0.001	0.001	0.02
Stem Rust	0	0	0.05
Strawbreaker	0	0	0.01
Ceph Stripe	0	0	0.001
American Wheat Stripe	0	0.001	0.001
Total	17.8	8.5	11.43

Source: Kansas State Department of Agriculture, Kansas Cooperative Plant Disease Survey Report: Preliminary 2007 Kansas Wheat Disease Loss Estimates, www.ksda.gov/plant_protection/content/183/cid/611

Probability of Future Occurrences

Possible: Level 2 Event is possible within the next 5 years.

Magnitude/Severity

Limited: Level 2 10% to 25 % of property severely damaged, shutdown of critical facilities for 24 hours or less.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.05	Moderate

3.2.3 Dam and Levee Failure

Description

The failure of dams or levees could result in injuries, loss of life, or damage to property, the environment and the economy. 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 fails or is washed out, the water behind is released as a flash flood. Failed dams can create floods that are catastrophic to life and property, in part because of the tremendous energy of the released water.

- **High Hazard Dam:** (also known as a Class C dam) 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 for significant hazard dams (hazard class B dams)
- **Significant Hazard Dam:** (also known as a Class B dam) 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 certain requirements, 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.

-
- Low Hazard Dam: (also known as a Class A dam) 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 low hazard dams.

Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which causes most failures;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- Landslides into reservoirs, which cause surges that result in overtopping;
- High winds, which can cause significant wave action and result in substantial erosion; and
- Earthquakes, which typically cause longitudinal cracks at the tops of embankments and weaken entire structures.

In general, warning time depends on the causal factors. Dam failure can occur in as little as a few minutes or more slowly over the course of many months. In the event of a catastrophic failure of a large dam, evacuation time for locations directly downstream would be extremely brief. Floodplain characteristics largely determine the available warning time for locations further downstream. Duration of high water conditions that result from dam failure depends on the capacity and stage of the reservoir at time of breach as well as the severity of the breach. Warning time and duration of levee failure is generally shorter than dam failure.

Warning Time: Level 2 12-24 hours

Duration: Level 4 More than 1 week

Geographic Location

Dams

Data from the National Inventory of Dams and State of Kansas indicates that Douglas County has 92 dams, 6 high hazard dams, 2 significant hazard dams and 84 low hazard dams. Table 3.7 has a list of the high hazard dams. Figure 3.2 follows with the locations of the high hazard dams. Figure 3.3 shows the locations of the high, significant, and low hazard dams in Douglas County.

Table 3.7 High Hazard Dams

WSN	Site Name	Owner	Stream Name	Dam Height
DDG-0272	CLINTON DAM	CORPS OF ENGINEERS	WAKARUSA RIVER	114.00
DDG-0287	DD NO 7-35	TAUY CREEK WJD NO 82	WEST BRANCH TAUY CREEK-TR	26.20
DDG-0163	FRD NO 31	WAKARUSA WJD NO 35	WAKARUSA RIVER-TR	40.30
DDG-0193	FRD NO 24	WAKARUSA WJD NO 35	YANKEE TANK CREEK	44.00
DDG-0201	FRD NO 26	WAKARUSA WJD NO 35	CHICKEN CREEK-TR	47.00
DDG-0014	LONE STAR LAKE	DOUGLAS COUNTY	WASHINGTON CREEK	71.00

Figure 3.2 High Hazard Dams in Douglas County

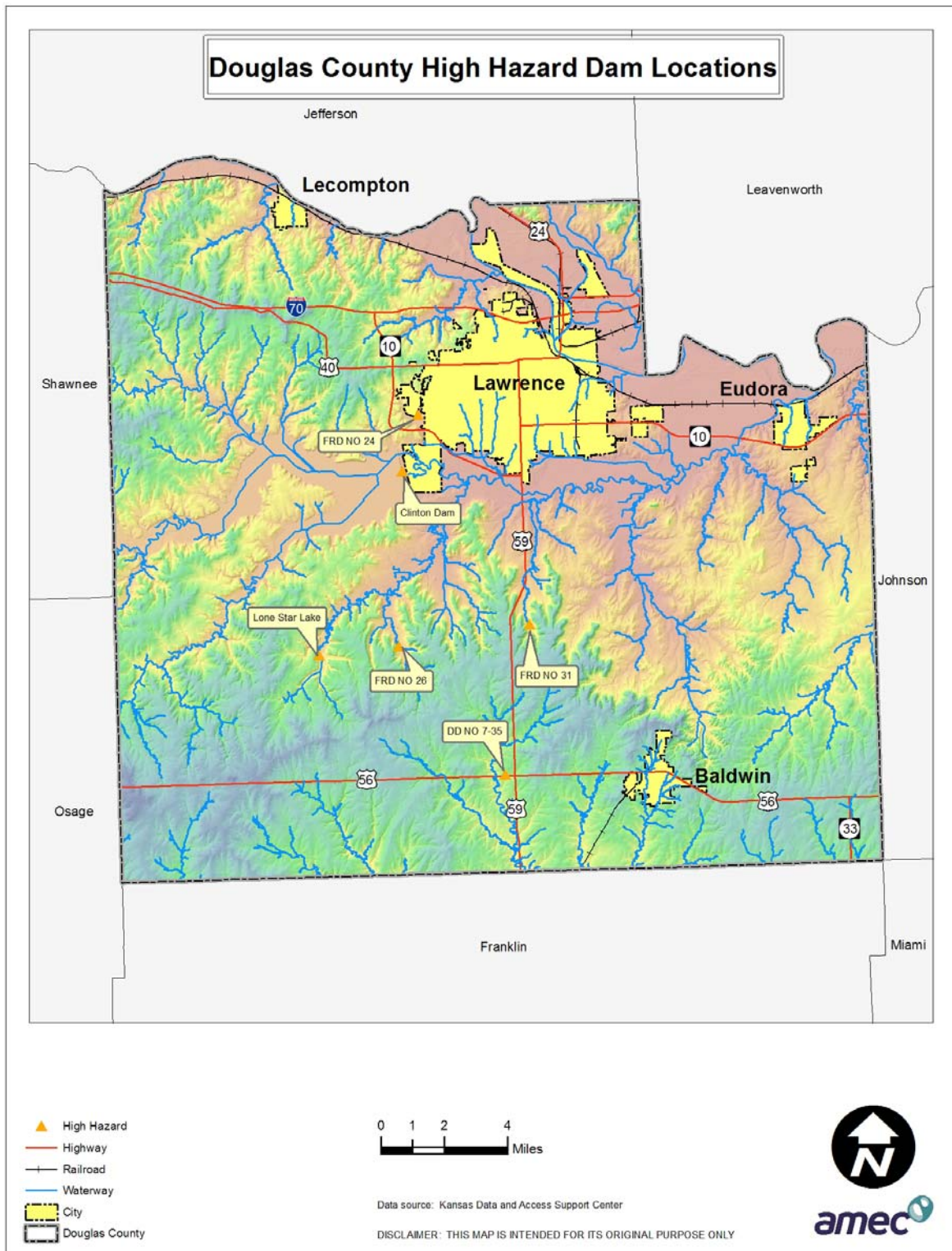
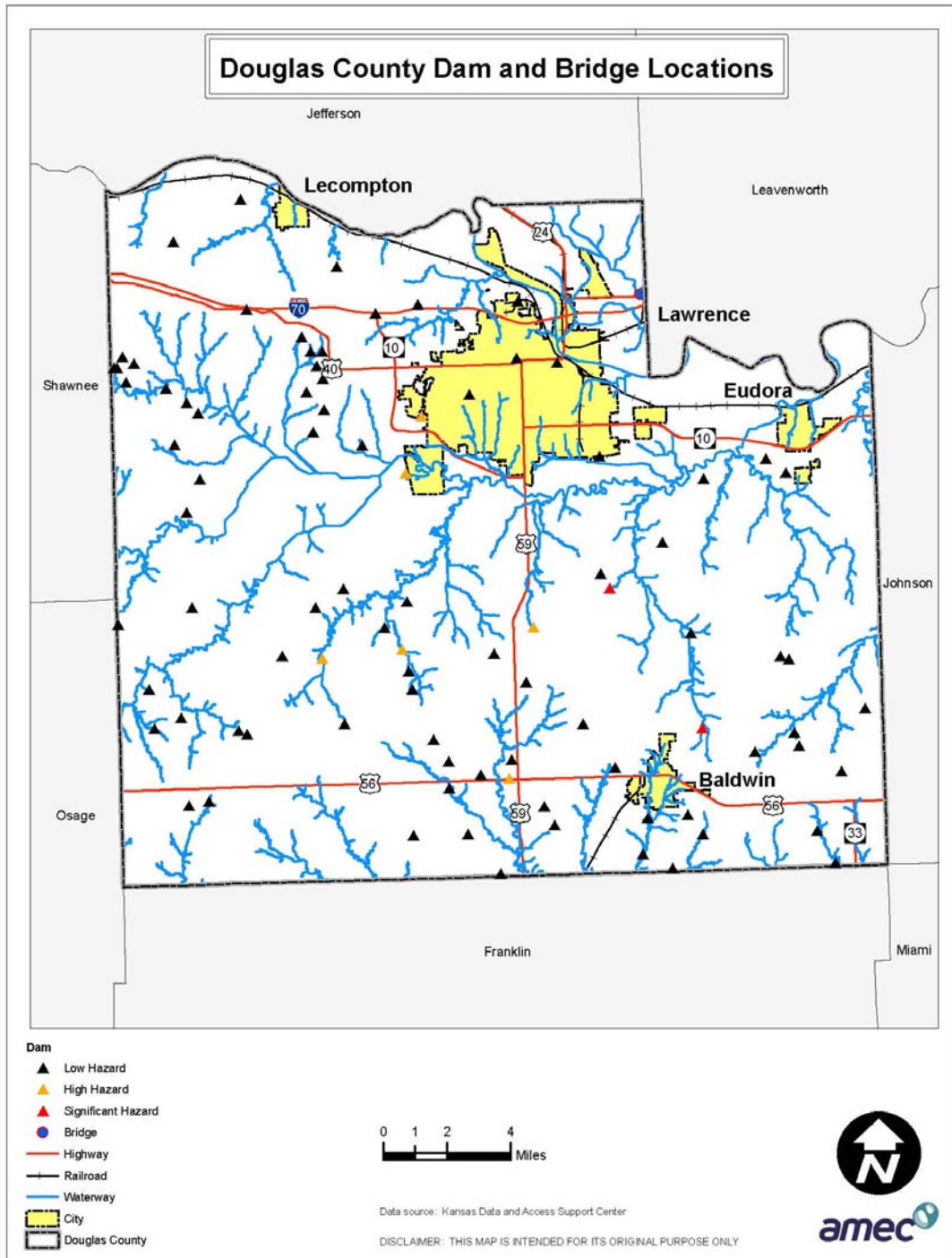


Figure 3.3 Dams and Bridges in Douglas County

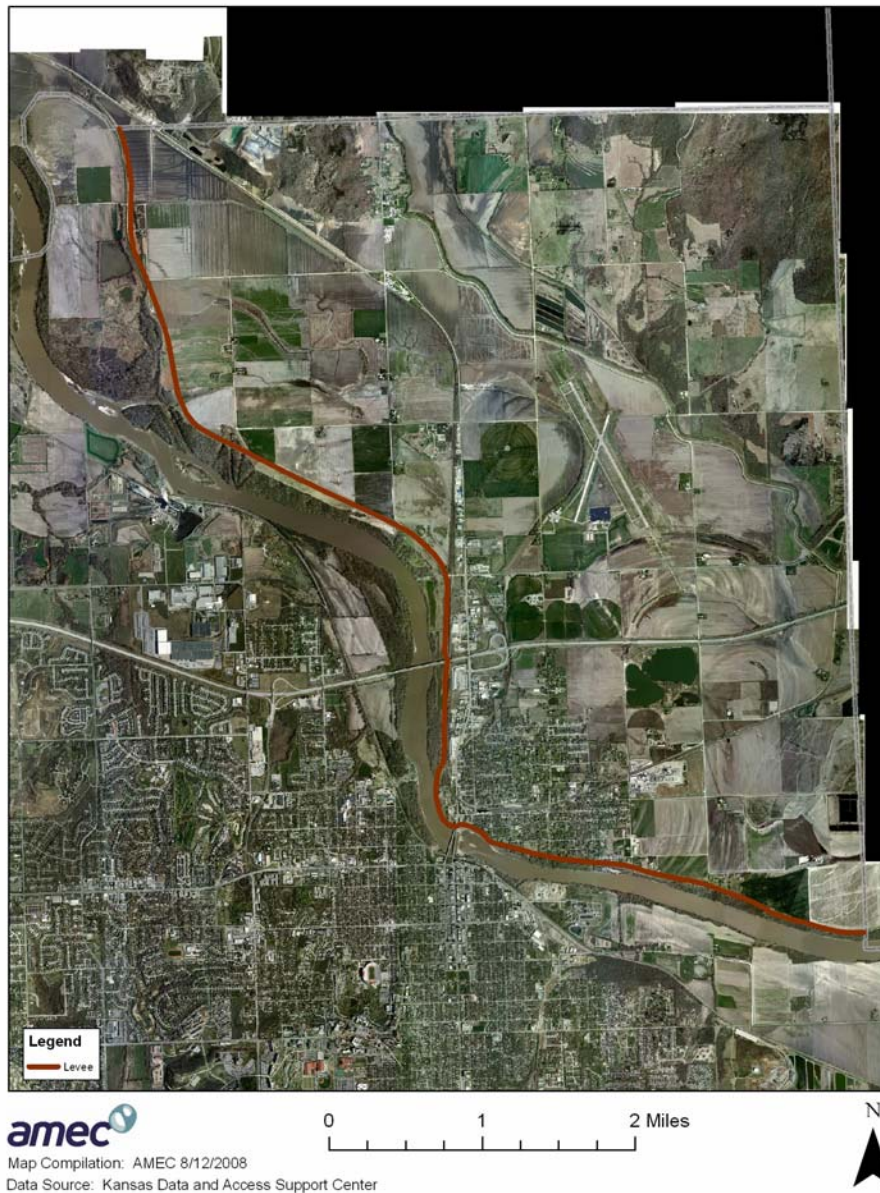


Levees

There is one levee on the Kansas River protecting the City of Lawrence from flooding. The levee is shown in Figure 3.4.

Figure 3.4 Kansas River Levee Protecting Lawrence, Kansas

Kansas River Levee, Douglas County



Previous Occurrences

There have been no previous reported dam or levee failures in Douglas County.

Probability of Future Occurrences

Using the methodology adopted for natural hazards in this plan, the probability of dam breach in Douglas County is unlikely. Based on the past performances of the levee in the City of Lawrence, it is unlikely to fail during a 100 year flood event. However, because dam and levee failure is a manmade hazard, the methodology for calculating probability based on past occurrences does not necessarily reflect the actual risk of future occurrence. Further information on this risk is unknown.

Unlikely: Level 1 History of events is less than or equal to 10 percent likely per year.

Magnitude/Severity

Due to the Clinton Lake Dam and the Wakarusa Reservoir Dam (FRD No 24) in the City of Lawrence, the HMPC determined that if a worst-case scenario of dam failure were to occur, the impact would be catastrophic.

Catastrophic: Level 4 More than 50 percent of property severely damaged; shutdown of facilities for 30 days or more; and/or multiple deaths.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.35	Moderate

3.2.4 Drought

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. 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.

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.

Warning Time: Level 1 More than 24 hours

Duration: Level 4 More than one week

Geographic Location

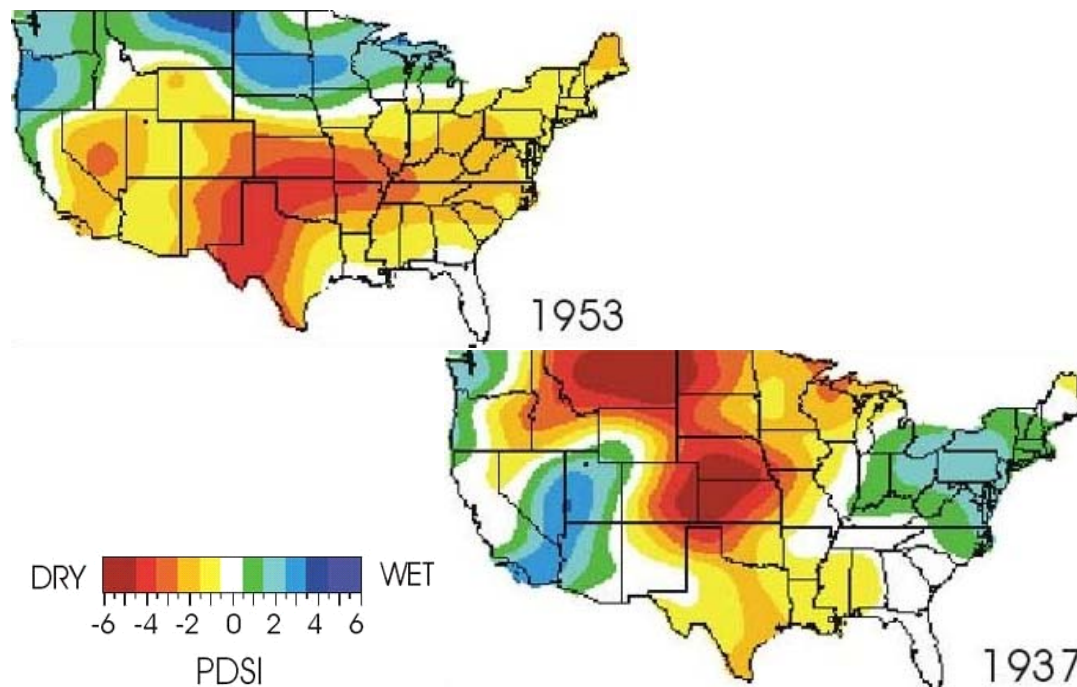
The entire planning area is subject to drought conditions. The impacts of prolonged drought are greatest in those areas of the county that are primarily agricultural. Sixty-seven percent of the 303,360 acres in Douglas County are used for agricultural purposes such as pasture for livestock grazing or fields planted with crops.

Previous Occurrences

Historical droughts occurred in 1860, 1872, 1874, 1901, 1930s, and 1950s.

Figure 3.5 shows the precipitation levels across the United States during the droughts in the 1950s and 1930s. In 1953, Douglas County was part of the dry area of the country (shaded light red). In 1937, Douglas County and other northeast Kansas counties fared slightly better than the rest of the state; but were nonetheless very short on precipitation. The most recent prolonged drought period in Kansas occurred from 1988-1991. Most areas of the state were affected (Kansas Water Office). During the period from 2003 to 2007, Douglas County was included in two drought watch declarations and three drought warning declarations. According to the point system utilized by the Kansas Water Office, Douglas County received 8 points during this time frame (1 point for each watch declaration, and 2 points for each warning declaration).

Figure 3.5 Historical Droughts 1953 and 1937



Source: National Oceanic and Atmospheric Administration, http://www.ncdc.noaa.gov/paleo/drought/images/temporal_spatial.jpg

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: online 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 (<http://droughtreporter.unl.edu/>) contains information on 55 drought impacts from droughts that affected Douglas County between 1993 and 2008. The list is not comprehensive. Most of the impacts, 28, were classified as “agriculture.” Other impacts include, “fire” (4), and “water/energy” (9). These categories are described as follows:

- **Agriculture** Impacts associated with agriculture, farming, and ranching. Examples include damage to crop quality, income loss for farmers due to 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.

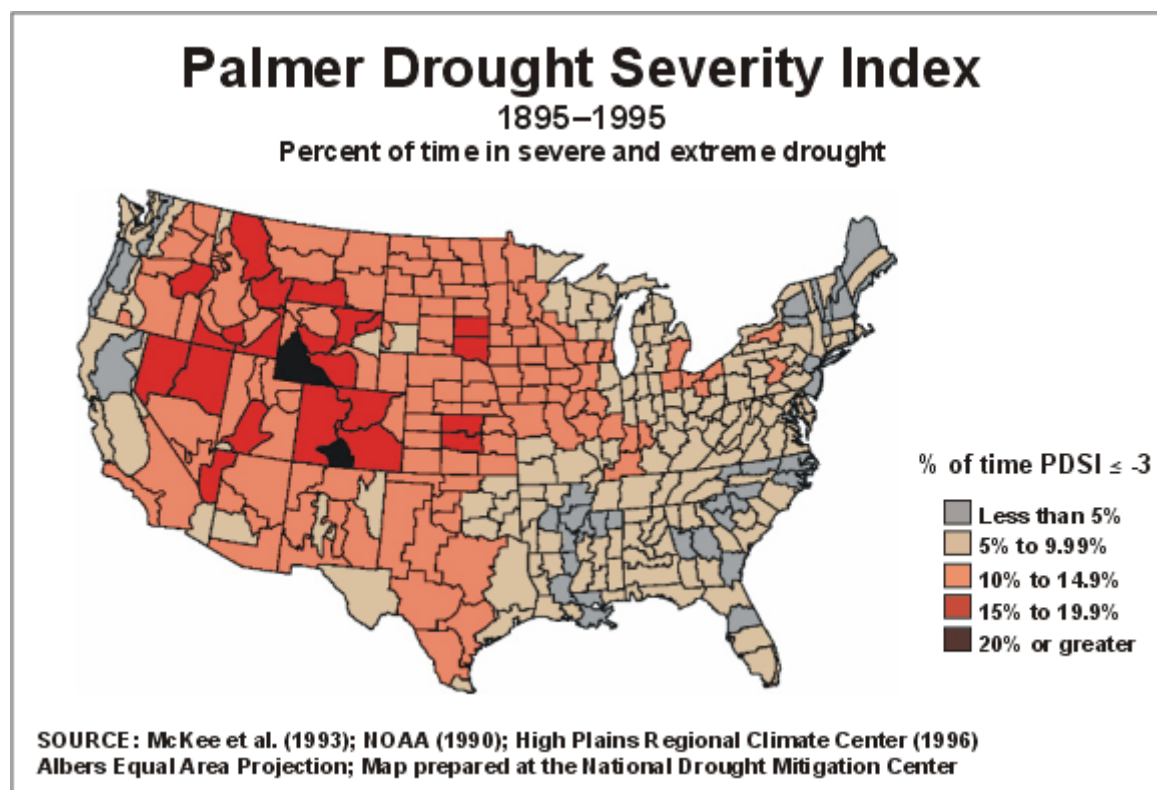
- **Fire** Impacts associated with forest and range fires that occur during drought events. The relationship between fires and droughts is very complex. Not all fires are caused by droughts and serious fires can result when droughts are not taking place.

Probability of Future Occurrences

Over short timeframes it is difficult to determine the probability of drought, but the study of drought cycles over longer periods indicate certain levels of historic frequency that can assist forecasters. According to the Palmer Drought Severity Index 1895-1995, Douglas County experienced severe and extreme drought 10-14.9 percent of the time during that 100-year period. Figure 3.6 shows how Douglas County compared to the rest of the state and the nation with respect to the amount of time spent in drought during this 100-year period. As a result of drought conditions that have occurred during the last decade, the HMPC determined that this hazard should receive a probability ranking of “likely”.

Likely: Level 3 Event is possible within the next three years

Figure 3.6 United States Percent of Time in Drought, 1895–1995



Magnitude/Severity

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in Kansas are those related to agriculture.

According to the 2006 Kansas Agricultural Statistics Farm Facts, there are 202,000 acres classified as farm land in Douglas County. This represents 66.7 percent of the total acres in the county. Of those, 105,300 are crop-producing acres. In 2006, the value of crops harvested in Douglas County was \$20,607,000. A prolonged drought could severely impact the agricultural economic base in Douglas County. Drought can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. An ongoing drought may also leave an area more prone to wildfires.

Water supply can also be of concern during periods of prolonged drought. A 2006 assessment of 800 city or rural water district drinking water systems by the Kansas Water Office did not indicate that water suppliers in Douglas County are particularly vulnerable to drought. Drought impacts increase with the length of a drought. Based on these assessments magnitude and severity of drought was considered “limited” by the HMPC.

Limited: Level 2 10% to 25 % of property severely damaged, shutdown of critical facilities for 24 hours or less.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.50	Moderate

3.2.5 Earthquake

Description

Earthquakes can be one of nature’s most damaging hazards. An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of Earth’s tectonic plates. The severity of these effects is dependent on the amount of energy released from the fault or epicenter.

Kansas experiences small earthquakes on a routine basis, but few are of a magnitude that causes damage to buildings or the infrastructure. According to a 2001 FEMA report, Kansas ranks 45th among the states in the amount of damage caused by earthquakes in an average year.

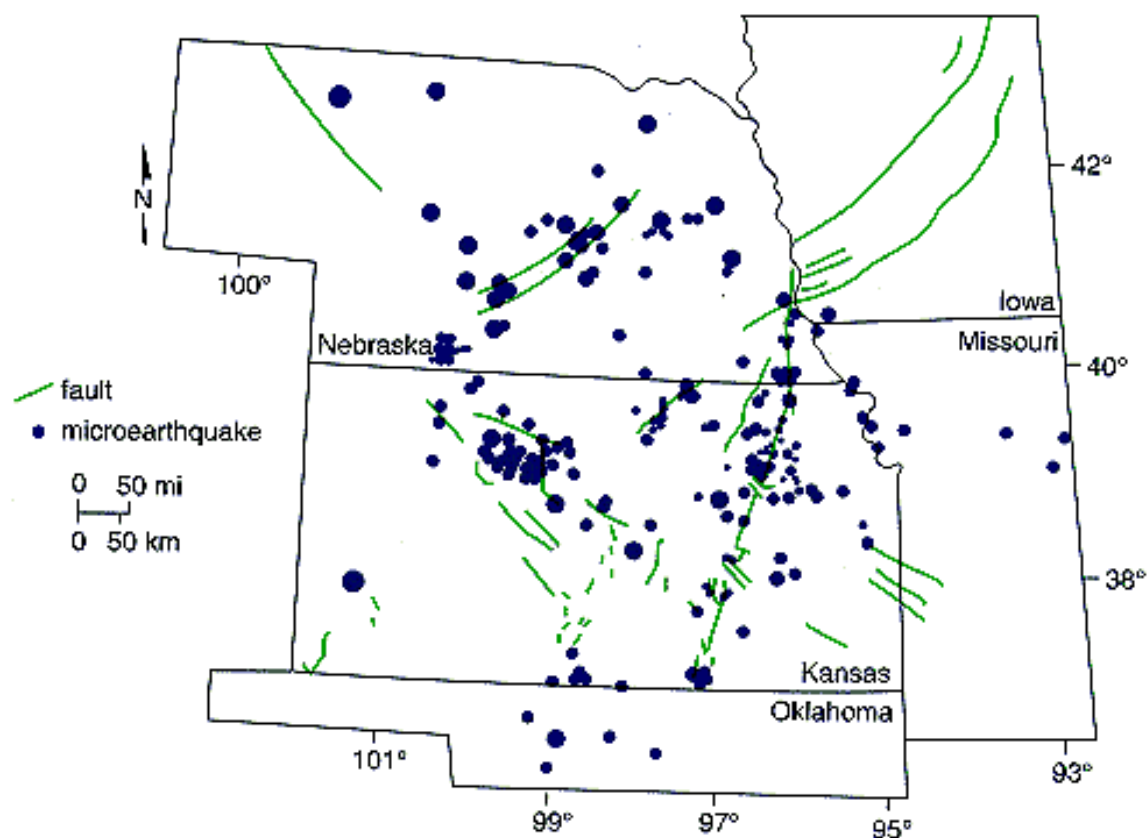
Warning Time: Level 4 Less than six hours

Duration: Level 1 Less than six hours.

Geographic Location

Overall, Kansas is in an area of relatively low seismic activity. The series of faults closest to Douglas County is called the Humboldt Fault Zone, which runs through Riley and Pottawatomie counties and extends south along the Nemaha Ridge also known as the Nemaha Uplift. The earthquake hazard is the same across the entire Douglas County Planning Area, including participating jurisdictions. The New Madrid Seismic Zone follows the Mississippi River valley from southeastern Missouri to northwestern Mississippi. While it is unlikely that Douglas County would receive extensive damage from a large New Madrid Seismic Zone event, it is possible that ground shaking would be noticed.

Figure 3.7 Locations of Seismic Faults and Historic Microearthquakes in Kansas

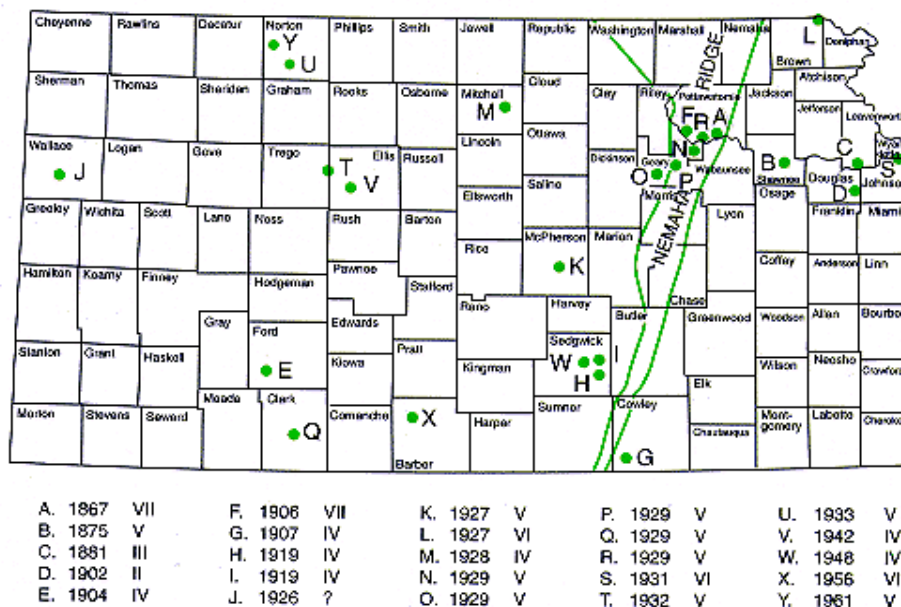


Source: Kansas Geological Survey, http://www.kgs.ku.edu/Publications/pic3/pic3_4.html

Previous Occurrences

Douglas County and Kansas in general are in areas of relatively little seismic activity. According to a 2001 FEMA report, Kansas ranks 45th among the states in the amount of damage caused by earthquakes in an average year. Figure 3.8 provided by the USGS, shows that Douglas County has only one recorded historical earthquake which occurred in 1902. The earthquake was ranked as a low intensity II quake.

Figure 3.8 Historical earthquakes in Kansas, prior to 1977



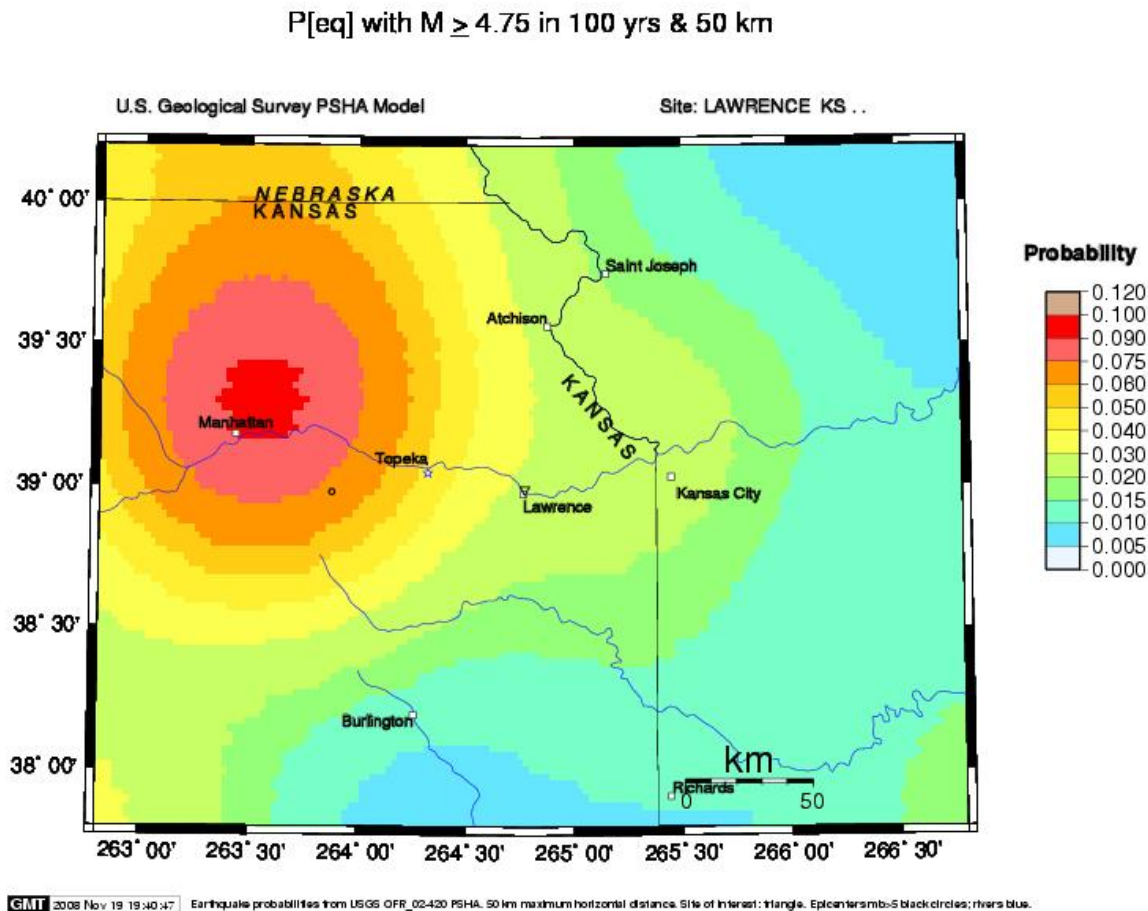
Source: USGS, <http://earthquake.usgs.gov/regional/states/kansas/hazards.php>

Probability of Future Occurrences

Figure 3.9 demonstrates that the probability of an earthquake with a magnitude greater than 4.5 in Douglas County in a 100 year time period is 2 percent to 3 percent. Therefore, the probability of a significant earthquake in any given year is unlikely.

Unlikely: Level 1 History of events is less than or equal to 10 percent likely per year

Figure 3.9 Kansas Seismic Hazard Map Probability of Magnitude 4.5 or Greater



Source: U.S. Geological Survey, <http://eqint.cr.usgs.gov/eqprob/2002/index.php>

Magnitude/Severity

The amount of energy released during an earthquake is most commonly expressed on the moment magnitude scale and is measured directly from energy released from the fault or epicenter as recorded on seismographs. Another measure of earthquake magnitude is intensity. Intensity is an expression of the amount of shaking at any given location on the surface as felt by humans and defined by the Modified Mercalli Intensity Scale. It is typically the greatest cause of losses to structures during earthquakes and is determined by many factors including distance from epicenter and soil types. Table 3.8 features abbreviated descriptions of the 12 levels of intensity. Damage done by previous earthquakes that affected Douglas County was limited to minor breakage of windows and items thrown from shelves. The HMPC assigned a magnitude of “limited” to this hazard.

Limited: Level 2 10% to 25% of property severely damaged, shutdown of facilities and services for more than a week

Table 3.8 Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Multi-Hazard Identification and Risk Assessment, FEMA 1997

Hazard Summary

Calculated Priority Risk Index	Planning Significance
1.75	Low

3.2.6 Expansive Soils

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 due to changes in moisture content. For Kansas, the vulnerability to this hazard most frequently is associated with soils shrinking during periods of drought.

Warning Time: Level 1 Less than 24 hours

Duration: Level 4 More than one week

Geographic Location

Figure 3.10 shows a map of the swelling potential of soils in Kansas. All of Douglas County is located in an area where part of the soil unit (generally less than 50 percent) consists of clay having slight to moderate swelling potential. More detailed data on how these soils vary within the Douglas County planning area was not available. Therefore, for the purposes of this plan, the hazard is considered to affect all participating jurisdictions.

Previous Occurrences

Streets and parking lots throughout the county are damaged every year by the effects of expansive soils as well as underground water lines that are damaged as the soil expands and contracts at varying levels along a water line. The frequency of damage from expansive soils can be associated with the cycles of drought and heavy rainfall, which reflect changes in moisture content. There is no available data for the planning area specific to damages resulting from expansive soils. These damages are largely isolated incidents and affected property owners make any necessary repairs.

Figure 3.10 Swelling Soils Map of Kansas



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

Source: U.S. Geological Survey publication, http://arcvoid.com/surevoid_web/soil_maps/ks.html

Probability of Future Occurrences

Although there will continue to be some damage to paved areas and foundations in Douglas County due to swelling soils, it is unlikely that these damages will become greater in the future unless new development occurs in areas where the hazard is more severe. The HMPC determined that damage to assets in the planning area due to expansive soils is likely in any given year.

Likely: Level 3 Event is probable within the next three years

Magnitude/Severity

The HMPC determined that the impacts to the planning area from expansive soils are, for the most part, minor in nature and are handled by individual property owners.

Limited: Level 2 10% to 25% of property severely damaged

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.50	Moderate

3.2.7 Extreme Temperatures

Description

Extreme temperature events, both hot and cold, can have severe impacts on human health and mortality, natural ecosystems, agriculture, and other economic sectors. According to information provided by the FEMA web site, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. The National Weather Service has a system in place to initiate alert procedures (advisories or warnings) when the Heat Index (HI) is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for the issuance of excessive heat alerts is when the maximum daytime HI is expected to equal or exceed 105°F and the night time minimum HI is 80°F or above for two or more consecutive days. Extreme heat is largely a public health issue and a livestock issue in agricultural counties such as Douglas County. In a normal year, about 175 Americans are killed by summer heat.

The definition of extreme cold varies based on usual temperatures, but in Kansas, extreme cold is usually defined in terms of wind chill index, a measure of both wind conditions and temperature. The National Weather Service has a system in place to initiate alert procedures (advisories or warnings) when the wind chill index is expected to have a significant impact on public safety. The expected severity of the wind chill determines whether advisories or warnings

are issued. In Kansas, wind chill advisories are issued for wind chills between -20 and -35 degrees Fahrenheit, and wind chill warnings are issued for wind chills below -35 degrees Fahrenheit. Extreme cold is a dangerous situation that can bring on health emergencies in susceptible people, such as those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat.

The elderly, small children, chronic invalids, those on certain medications or drugs, and individuals with weight and alcohol problems are particularly susceptible to heat and cold reactions. In agricultural areas, the exposure of farm workers to extreme temperatures is a major concern. Death of livestock is also a concern.

Warning Time: Level 1 More than 24 hours

Duration: Level 4 More than one week

Geographic Location

The entire planning area is subject to extreme heat events and extreme cold and all participating jurisdictions are affected.

Previous Occurrences

Since 1980 there have been 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. During this time frame, agricultural and related industries experienced an estimated \$44 billion in damage. Similarly, in a 1988 heat wave in the central United States, between 5,000 to 10,000 lives were lost to the heat, and the toll on agriculture was \$56 billion. There is no data regarding lives lost or economic impact associated with extreme temperatures specifically for Douglas County.

During the period from 1993-2008, the National Climatic Data Center (NCDC) database lists nineteen (19) incidents of extreme temperatures in Douglas County. Of those, ten (10) were related to extreme cold and six (6) to extreme heat. Some examples include:

- **9/22/1995:** The earliest freeze on record hit most of northcentral and northeast Kansas causing widespread and heavy damage to immature crops. Temperatures dropped as low as the mid 20s, and persisted from three to six hours. Some low temperatures included: 26 degrees at Glasco and Manhattan, 27 degrees at Emmett, Frankfort and Courtland, 30 degrees at John Redmond Lake, Minneapolis, Clinton Lake and Garnett to 36 degrees at Milford Lake. Most readings were between 26 and 31 degrees.
- **7/15/1999 to 7/30/1999:** Excessive heat occurred over the area throughout the month. But an approximate 2 week string of days during the last half of the month seemed to be the worst. Temperatures during this two week period exceeded 100 degrees in many areas on many days. The excessive heat was also accompanied by very high heat indices that exceeded 110

degrees at times. A Lyon county man in his 20s suffered dehydration and died from heat stroke.

- **8/1/2000 to 8/31/2000:** Temperatures rose at or above 95 degrees from as few as 15 days at Horton (Brown County-north of Douglas County) to as many as 29 days at Minneapolis (Ottawa County - west of Douglas County). Days of 100 degrees or higher ranged from as few as 2 at Lane (Franklin County - south of Douglas County) to as many as 27 at Minneapolis. The last half of the month was especially hot with nearly all of the monthly highest temperatures reached during this time period. Minneapolis recorded the highest temperature in the area when 112 degrees was reached on the 25th. Minneapolis also had 4 days during the month with high temperatures at or above 110 degrees. At least 14 people were treated for heat related illnesses, but fortunately there were no fatalities.
- **4/4/2007 to 4/15/2007:** The severe freeze in Douglas County damaged early spring crops across the county. Local farmers reported that they had never before seen a late spring freeze that had been as damaging. The passage of a cold front April 3rd drove cold arctic air into the Central Plains States, and forced temperatures to plummet to some of the coolest readings ever recorded during early April. Temperatures dipped down into the middle to upper teens overnight the 6th and the 7th across northeast Kansas, which brought a hard freeze to much of the state. Early season crops, including wheat, alfalfa, berries, spinach, and apples were significantly damaged by the cold. Cool weather and below normal temperatures continued for the next week, before a second round of very cold temperatures settled over Northeast Kansas the weekend of the 13th-15th, primarily across far Northeast and East Central Kansas. Unfortunately, the end of March recorded unseasonably warm temperatures. Crops had responded positively to the spring heat and flourished. The cold snap, though, left many of these same crops heavily damaged. The Kansas State Farm Services Agency reported that all 23 counties in the Topeka County Warning Area recorded a 30% or greater loss of the wheat and alfalfa crops in each respective county. Fruit trees and strawberries were some of the hardest hit crops by the late freeze. In addition, orchard and vineyard owners were likely to suffer the greatest economic losses. A Secretarial Natural Disaster was declared for northeast Kansas as a result of the prolonged spring freeze. The average latest date for the spring freeze across the Topeka County Warning Area ranges from April 3rd to April 23rd. Also, due to the extent and impact of the freeze, qualifying farmers in Anderson, Coffey, Douglas, Franklin, Osage and Shawnee counties were declared eligible to make emergency loan applications to the Farm Service Agency.

Table 3.9 charts the record temperatures by month from 1894 to 2008.

Table 3.9 Record Temperatures by Month 1894 to 2008

Month	Minimum Temp.	Maximum Temp	Month	Minimum Temp.	Maximum Temp.
January	-21	73	July	50	113
February	-25	84	August	42	114
March	-7	95	September	31	108
April	11	94	October	16	98
May	30	102	November	2	85
June	40	107	December	-21	76

Source: High Plains Regional Climate Center

http://www.hprcc.unl.edu/data/historical/index.php?state=ks&action=select_state&submit=Select_State

Probability of Future Occurrences

Periods of extreme heat and extreme cold generally occur on an annual basis, resulting in a probability rating of “highly likely”.

Highly Likely: Level 4 Event is probable within the calendar year.

Magnitude/Severity

Due to the potential for fatalities and the possibility for the loss of electric power, periods of extreme temperature can severely affect the planning area. In addition, accompanying drought may compound the problem exacerbating agricultural and economic losses.

Critical: Level 3 – 25% to 50% of property severely damaged; shutdown of facilities for more than two weeks; and/or injuries/illnesses result in permanent disability

Calculated Priority Risk Index	Planning Significance
3.25	High

3.2.8 Flood

Description

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. The National Weather Service reports that total property and crop damage due to flooding in the U.S. for 2006 was \$3.96 billion. Nationally, 76 fatalities and 23 injuries were attributed to flooding that same year.

There are several different types of potential flood events in Douglas County including riverine, flash flooding, and urban stormwater. Riverine floods result from precipitation over large areas. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include many independent river basins. Factors that directly affect the amount of flood runoff include precipitation, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface areas due to urbanization. The term

"flash flood" describes localized floods of great volume and short duration. In contrast to riverine flooding, this type of flood usually results from a heavy rainfall on a relatively small drainage area. Precipitation of this sort usually occurs in the spring and summer. Urban flood events result as land loses its ability to absorb rainfall as it is converted from fields or woodlands to roads, buildings, and parking lots. Urbanization increases runoff two to six times over what would occur on undeveloped terrain. During periods of urban flooding, streets can become swift moving rivers.

Regardless of the type of flood, the ultimate cause in nearly all cases is attributed to excessive rainfall, either in the flood area or upstream reaches of the watershed. Other causes include dam or levee failure, downstream conditions such as channel restriction, blockages of waterways and/or high flow of a confluence stream that can result in what is known as backwater flooding.

The area adjacent to a river channel is its floodplain. In its common usage, "floodplain" most often refers to that area that is inundated by the 100-year flood, the flood that has a 1 percent chance in any given year of being equaled or exceeded. The 1 percent annual flood is the national standard to which communities regulate their floodplains through the National Flood Insurance Program.

The National Weather Service (NWS) provides the following definitions of warnings for actual and potential flood conditions:

General flooding

- **Flood Potential Outlook:** In hydrologic terms, a NWS outlook that is issued to alert the public of potentially heavy rainfall that could send rivers and streams into flood or aggravate an existing flood.
- **Flood Watch:** Issued to inform the public and cooperating agencies that current and developing hydrometeorological conditions are such that there is a threat of flooding, but the occurrence is neither certain nor imminent.
- **Flood Warning:** In hydrologic terms, a release by the NWS to inform the public of flooding along larger streams in which there is a serious threat to life or property. A flood warning will usually contain river stage (level) forecasts.
- **Flood Statement:** In hydrologic terms, a statement issued by the NWS to inform the public of flooding along major streams in which there is not a serious threat to life or property. It may also follow a flood warning to give later information.

Flash floods

- **Flash Flood Watch:** Issued to indicate current or developing hydrologic conditions that are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain nor imminent.
- **Flash Flood Warning:** Issued to inform the public, emergency management and other cooperating agencies that flash flooding is in progress, imminent, or highly likely.

-
- **Flash Flood Statement:** In hydrologic terms, a statement by the NWS which provides follow-up information on flash flood watches and warnings.

The onset of flooding varies depending on the cause and type, with flash flooding and dam/levee failure inundation occurring typically with little or no warning time, whereas flooding caused by long periods of excessive rainfall tend to have longer durations but more gradual onset.

Warning Time: Level 3 6-12 hours

Duration: Level 4 More than one week

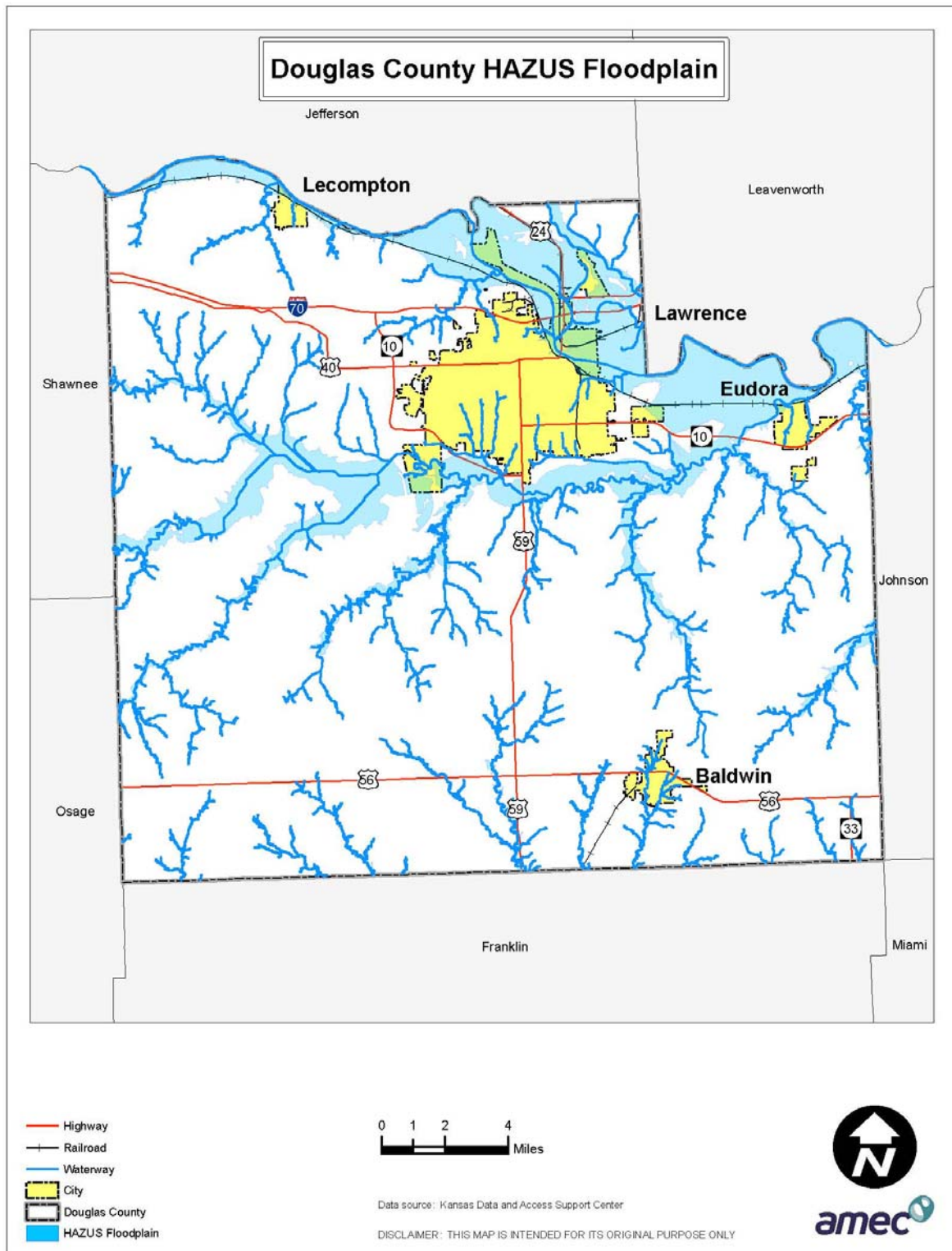
Geographic Location

In 2001, Douglas County conducted a flood insurance study which included the incorporated cities of Baldwin City, Eudora, Lawrence, Lecompton and the unincorporated county. According to that study, the principal flood problem areas include overflow from the Kansas and Wakarusa rivers which has caused periodic damage.

Floods on smaller streams in Douglas County have occurred after locally heavy rainstorms. Small drainage basin areas and steep slopes cause quick flood rises. Streams that flood during events include: Brook Street and Belle Haven Tributaries, Maple Grove Drainage, Hidden Valley Tributary (south of Clinton Parkway) and the KLWN Tributary in the City of Lawrence and Middle Creek Tributary in the City of Eudora.

The best available data for flood modeling in Douglas County was generated by HAZUS-MH MR3, FEMA's software program for estimating potential losses from disasters. HAZUS was used to model a flood inundation zone with a one percent annual probability for major rivers and creeks in the County. The inundation zone, or flood depth grid, estimates flooding depth based on location and elevation relative to the creek or river. While not as accurate as official flood maps, these floodplain boundaries are useful for GIS-based loss estimation. Note that HAZUS floodplain modeling occurred only on streams with a minimum drainage area of 10 square miles. Thus flooding on smaller basins, including urban runoff, may not be represented. HAZUS also used 30m resolution DEM for terrain data, which normally does not have sufficient detail to show levee features, thus existing levee protection could be ignored by this analysis. Figure 3.11 shows the HAZUS flood depth grid for Douglas County.

Figure 3.11 Douglas County 100-year Flood Hazard Modeled by HAZUS



Previous Occurrences

This section provides information on the 34 recorded flood events in Douglas County between 1951 and 2008 from the NCDC database. These events caused eight reported injuries, an estimated \$6.8 million in property damages and an estimated \$235,000 in crop damages. It should be noted that prior to 1993, flood data was available only on a limited basis for major floods. Minor floods and flash floods were not recorded prior to 1993 and it is highly likely that there were localized events prior to 1993 that were not recorded. Details of the 34 recorded events are provided in Table 3.10.

Table 3.10 Flood Events affecting Douglas County, Kansas 1993 to 2008

Location or County	Date	Time	Type	Injuries	Property Damages	Crop Damages
1 <u>Worden</u>	05/16/1995	11:00 PM	Flash Flood	0	0	25K
2 <u>Lawrence</u>	06/05/1996	10:55 PM	Flash Flood	3	2.0M	200K
3 <u>Lawrence</u>	06/06/1996	05:00 AM	Flash Flood	0	0	0
4 <u>KSZ010 - 026 - 037 040 - 054 056 - 059</u>	04/11/1997	03:00 AM	Flood	0	0	0
5 <u>Lawrence</u>	10/04/1998	05:00 PM	Flash Flood	5	1.1M	0
6 <u>Lawrence</u>	11/01/1998	09:45 AM	Flash Flood	0	2.5M	5K
7 <u>Lawrence</u>	04/22/1999	11:00 AM	Urban/sml Stream Fld	0	0	0
8 <u>KSZ021 024 - 026 - 038 040 - 054</u>	04/26/1999	06:00 AM	Flood	0	0	0
9 <u>Lawrence</u>	06/28/1999	06:50 AM	Urban/sml Stream Fld	0	0	0
10 <u>Lawrence</u>	06/20/2000	06:45 AM	Flash Flood	0	0	0
11 <u>Lawrence</u>	04/14/2001	06:00 PM	Flash Flood	0	0	0
12 <u>Pleasant Grove</u>	05/24/2002	09:15 PM	Flash Flood	0	0	0
13 <u>Lawrence</u>	07/19/2002	04:30 PM	Flash Flood	0	0	0
14 <u>KSZ020 022 - 034 040 - 054 056 - 058 059</u>	03/03/2004	06:00 AM	Flood	0	350K	0
15 <u>Lawrence</u>	07/02/2004	11:26 AM	Flash Flood	0	75K	5K
16 <u>Lawrence</u>	07/06/2004	03:45 AM	Flash Flood	0	0	0
17 <u>Lawrence</u>	07/24/2004	08:00 AM	Flash Flood	0	0	0
18 <u>Lawrence</u>	08/23/2004	08:45 PM	Flash Flood	0	0	0
19 <u>Lawrence</u>	08/24/2004	09:00 AM	Flash Flood	0	0	0
20 <u>Lawrence</u>	08/27/2004	08:02 PM	Flash Flood	0	0	0
21 <u>KSZ040</u>	08/28/2004	12:40 AM	Flood	0	0	0
22 <u>Lawrence</u>	05/12/2005	09:15 PM	Flash Flood	0	1K	0
23 <u>Lawrence</u>	06/30/2005	07:10 PM	Flash Flood	0	100K	0
24 <u>Lawrence</u>	08/13/2005	02:45 PM	Flash Flood	0	50K	0
25 <u>KSZ023 - 040</u>	09/23/2005	09:43 AM	Flood	0	190K	0

Location or County	Date	Time	Type	Injuries	Property Damages	Crop Damages
26 <u>Lawrence</u>	05/06/2007	07:13 AM	Flash Flood	0	50K	0K
27 <u>Lawrence</u>	05/07/2007	08:57 AM	Flood	0	255K	0K
28 <u>Baldwin</u>	06/07/2007	03:30 PM	Flash Flood	0	5K	0K
29 <u>Baldwin</u>	06/30/2007	11:50 AM	Flash Flood	0	30K	0K
30 <u>Lone Star</u>	06/30/2007	2:05 PM	Flash Flood	0	100K	0K
31 <u>Eudora</u>	10/17/2007	2:35 PM	Flash Flood	0	0K	0K
32 <u>Lawrence</u>	06/02/2008	10:50 AM	Flash Flood	0	0K	0K
33 <u>Lawrence</u>	06/08/2008	05:30 PM	Flash Flood	0	0K	0K
34 <u>Vinland</u>	06/12/2008	08:07 PM	Flash Flood	0	0K	0K

Presidential disaster declarations have been issued for nine (9) flood events involving Douglas County which are listed in Table 3.11. Narrative descriptions of some of the more significant events follow.

Table 3.11 Presidential Disaster Declarations for Flooding in Douglas County

Declaration Number	Declaration Date	Disaster Description	Public and Individual Assistance Provided to Douglas County
1699	5/6/2007 (5/4/2007)	Severe Storms, Tornadoes, and Flooding	Public Assistance: \$ 109,000 Individual Assistance: \$ 550
1579	2/8/2005 (1/4-6/2005)	Severe Winter Storm, Heavy Rains, and Flooding	Public Assistance: \$ 193,077
1562	09/30/2004 (8/27-30/2004)	Severe Storms, Flooding, and Tornadoes	Figures not available
1462	5/6/2003 (5/4-30/2003)	Severe Storms, Tornadoes, and Flooding	Individual Assistance: \$ 51,223
1258	11/5/1998 (10/30-11/15/1998)	Severe Storms and Flooding	Individual Assistance: \$2,113
1254	10/14/1998 (10/1-10/8/1998)	Severe Storms, Flooding, and Tornadoes	Public Assistance: \$ 5,022 Individual Assistance: \$ 9,562
1000	7/22/1993	Flooding, Severe Storms	Figures not available
644	7/18/1981	Severe Storms, Flooding, Tornadoes	Figures not available
403	9/28/1973	Severe Storms, Tornadoes, Flooding	Figures not available
378	5/2/1973	Severe Storms, Flooding	Figures not available
267	7/15/1969	Tornadoes, Severe Storms, Flooding	Figures not available
229	7/18/1967	Tornadoes, Severe Storms, Flooding	Figures not available
Sources: Federal Emergency Management Agency, www.fema.gov/ ; Public Entity Risk Institute, www.peripresdecusa.org/ Incident dates are in parentheses Kansas Division of Emergency Management Public and Individual Assistance as of 7/1/2008			

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- **1951:** The most severe flooding on the Kansas and Wakarusa rivers occurred in 1951. Total damage in the City of Lawrence alone was estimated at that time to be in excess of \$3,000,000. Nearly all of the agricultural areas in the Kansas and Wakarusa floodplains were inundated. The crops were declared a total loss.
 - **1993:** A continuous rain event affected many areas of northeast Kansas; however, the levees and reservoirs in place in Douglas County protected many of the communities from flooding problems. Flooding still affected the unprotected portions of the rivers. An estimated \$1,500,000 in damages was sustained in the County including the Grant and Wakarusa townships and the City of Lecompton. The City of Lawrence was affected also, but to a lesser degree than in the 1951 flood event. The City reported \$1,200,000 in damages in 1993.
 - **6/5/1996 to 6/6/1996:** Rainfall of around 8 inches in about 24 hours produced widespread severe flash flooding in and around the City of Lawrence during the late night and early morning hours. At least 2 cars were swept off 23rd street into Naismith creek, and occupants of the cars had to be rescued by emergency crews. One of the cars was in a vertical position at the bridge trapping the person inside who nearly drowned before being rescued. Flood waters covered nearly all city streets at one time or another and stalled cars were numerous. The high waters closed Interstate 70 for about 2 hours 3 miles west of Lawrence. Three injuries were attributed to the flash flooding which was considered the worst since the summer of 1993. Damages from this storm were estimated at \$2,000,000 in property damage and \$200,000 in crop damage.
 - **10/4/1998 to 10/5/1998:** Thunderstorms from the afternoon of the 4th to the early morning of the 5th produced heavy rains and flash flooding across counties of northeast and east central Kansas. There were numerous reports of road closures, stalled vehicles and stranded motorists. Road closures included US Highway 24 from Williamstown to Midland Junction, Highway 31 between US highway 75 and Osage City as well as some county roads over the area. Seven people were stranded near Ottawa after their vehicles were swept off the road. All were rescued. Two boys were rescued from high water near Ottawa. Officers rescued 5 people and 2 dogs stranded in high waters near Lawrence. Some streets in Emporia and Lawrence were closed for a time due to high water. At least 1 church was heavily damaged as were several homes. A mudslide near a former railroad overpass north of Lyndon caused the closure of US highway 75 for a time. Five minor injuries occurred in Lawrence from traffic accidents caused by the flooding. Total property damage in the affected counties totaled nearly \$1.5 million.
 - **3/3/2004 to 3/4/2004:** Heavy rain of 3 to 4 inches over several days produced areas of flooding. Many farm fields had standing water on them. Some rivers and streams temporarily flooded and excess runoff closed many roads for a time. Some roads and bridges were washed out or damaged. Two people were rescued from a vehicle that was swept off a road near Emporia.
 - **9/23/2005:** Up to 6 inches of heavy rain from overnight thunderstorms brought extensive flooding and flash flooding along the Kansas River Valley from near St. Marys to Lawrence. The 5.61 inches of rain that fell in Topeka broke the one-day rainfall record for the city.

Sewers backed up and basements were flooded in some homes within the city. A few cars were found floating in the flooded streets. Water rescues were made on stranded motorists by firefighters just northwest of Topeka. Numerous roads were flooded by deep ponded water and some were closed by water up to six feet deep. The Perry High School football stadium was flooded by 6 inches of rain during the morning hours and school officials were pumping the water off in an effort to make the field available for a game that evening. Fortunately, no injuries were reported through all the flooded areas. The heavy rains also forced gasoline storage tanks to surface through the concrete pavement of a gasoline station in Lawrence. Total property damage estimates totaled \$190,000.

- **5/7/2007 to 5/8/2007:** Several county roads were closed. There were also several road closures within Lawrence city limits. A non-emergency water rescue was performed for a resident who had water all around their house. Another round of heavy rain producing thunderstorms caused flash flooding. The community of Wakarusa had a few water rescues. The accumulation of rain from this episode along with earlier rains brought moderate or greater flooding to some of the major rivers in the area. This river flooding lasted for several more days. In total, the event produced widespread amounts of 3 to 6 inches with some amounts along the Kansas River basin of nearly 9 inches. A presidential disaster declaration was issued for Osage, Lyon, Shawnee, Washington and Douglas counties. This action qualified these counties for state and federal aid. Shawnee, Osage, Lyon and Douglas counties qualified for FEMA funds. Total damages were estimated at \$255,000.
- **6/30/2007:** County Road 1 was closed one mile north of Globe. There were numerous reports of flash flooding over roadways east of Vinland to the Clinton Lake area including inundation of low water crossings. Parts of Douglas and Lyon counties received from 4 to 8 inches of range. Forty to fifty homes were evacuated in Franklin County just south of Douglas County with 10 to 15 alone in the small community of Lane. Several swift water rescues were done in Anderson and Coffey counties, some with the assistance of a Black Hawk helicopter.

Probability of Future Occurrences

Based on the detailed historical data available from 1993 to the present, there were 34 flood events in 14 years. This results in a probability of 100 percent for a given year for at least minor flooding. When considering significant events, there have been at least 15 over the 14-year period from 1993 to the present in Douglas County. Considering that there are minor and flash flood events that were not used in determining this factor, it is reasonable to determine that the probability of future flooding in Douglas County is highly likely.

Highly Likely: Level 4 Event is probable within the next calendar year

Magnitude/Severity

Past flood events in Douglas County have caused significant damage to property and agriculture, endangered lives, and shut down critical facilities and infrastructure, such as roads and schools. Properties that have received two or more claim payments of more than \$1,000 from the National Flood Insurance Program within any rolling 10-year period are considered Repetitive Loss (RL) structures. There are currently 3 properties in Lawrence, 1 property in Eudora, and 1 property in unincorporated Douglas County that are considered repetitive loss properties.

Critical: Level 3 25% - 50% of property severely damaged; shutdown of facilities for at least two weeks; injuries and/or illnesses result in permanent disability

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.55	High

3.2.9 Fog

Description

Fog results from air being cooled to the point where 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. 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 water into the atmosphere. This is called radiation fog. A warm moist air mass blowing over a cold surface also can cause fog to form, which is called 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.

Warning Time: Level 2 12-24 hours

Duration: Level 1 Less than 6 hours

Geographic Location

The entire planning area, including all participating jurisdictions, is at risk to fog if conditions are present. The low-lying areas are at increased risk due to the nature of fog to settle in these areas.

Previous Occurrences

According to the Kansas Department of Transportation's 2007 Summary of Kansas Traffic Accident Facts, in 2007, 121 vehicle crashes reported fog, smoke or smog as a contributing circumstance to the accident. County-level specific data was not available.

Probability of Future Occurrences

Fog does occur in the planning area on a frequent basis, and HMPC members report that damages from motor vehicle accidents directly related to the fog conditions do occur.

Highly Likely: Level 4 Event is probable within the next year

Magnitude/Severity

Limited: Level 2 10% to 25% of property severely damaged; shutdown of facilities and services for more than one week; and/or injuries/illnesses do not result in permanent disability

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.80	Moderate

3.2.10 Hailstorm

Description

Hailstorms in Kansas cause damage to property, crops, and the environment and kill and injure livestock. Because of the large agricultural industry in Kansas, 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. In 2005, hail and wind damage made up 45 percent of homeowners insurance losses. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. In urban areas, motor vehicle dealers can experience serious insured losses related to hail damage

from even minor storms. Hail has been known to cause injury to humans, and occasionally has been fatal.

Warning Time: Level 4 less than 6 hours

Duration: Level 1 less than 6 hours

Geographic Location

The entire planning area, including all participating jurisdictions, is at risk to hailstorms.

Previous Occurrences

The NCDC reports 254 hail events in Douglas County between 1955 and 2008 causing a reported \$5,515,000 in property damage and \$515,000 in crop damages. Table 3.12 shows the number of hail events by the size of the hail and frequency of storms by year. During the period of 2000 to 2002 there were 24 or more storms each year.

Table 3.12 Hail Events Summarized by Hail Size (in inches) and Frequency by Year

Hail Size (inches)	# of Events 1955 to 2008	Year	Number of Reported Hail Storms
0.75	78	1999	5
0.88	23	2000	25
1.00	70	2001	24
1.25	11	2002	25
1.50	10	2003	18
1.75	38	2004	9
2.00	15	2005	12
2.50	5	2006	16
2.75	2	2007	1
3.00	2	2008	19

Source National Climatic Data Center Storm Events Database

Descriptions of some of the more damaging events are provided below:

- **4/23/2006:** Between 8:50 p.m. and 9:03 p.m., many reports of hail ranging from 0.75" to 2.50" in diameter were received from the City of Lawrence as a supercell thunderstorm moved through. The largest reported hail fell on the campus of Kansas University. State Farm Insurance reported an expected \$1.8 million in auto claims for damaged vehicles; American Family Insurance was expecting up to 600 auto claims and 300 home claims to be filed.
- **3/24/1997:** Large hail produced widespread damage to cars, including more than 600 vehicles at automobile dealerships. The hail combined with strong winds to damage a total of 17 windows at two sets of apartments. Most of the damage occurred on the north side of town where the hail reached the size of golf balls.

- **9/21/93:** The supercell thunderstorm that moved across parts of northeast Kansas hit the northern half of Douglas County including the City of Lawrence at late afternoon. Numerous and widespread reports of large hail and winds clocked at 66 knots caused significant and large scale damage from near Lecompton to Lawrence to Eudora. Many power lines were brought down along with trees and large limbs. Hail damage was common across Lawrence. Torrential rainfall in a short time flooded many roads. In some areas, winds were estimated at 100 mph. The storm briefly stalled across the northwest part of the county before regenerating and moving slowly east again. The NCDC reported \$500,000 in property damage, and \$500,000 in crop damage due to this hailstorm.

Probability of Future Occurrences

Based on data available from the NCDC, there have been 254 events in a 53 year period, producing an average of 4.8 hail events each year in Douglas County. When limiting the probability analysis to hail events producing hail 1.5 inches and larger, there have been 72 events in a 53 year period producing a greater than 100% chance in any given year that hail events of this size will occur. Even considering only the more significant events, this analysis produces a probability of highly likely.

Highly Likely: Level 4 Event is probable within the calendar year.

Magnitude/Severity

Limited: Level 2 10 % to 25% of property severely damaged; shutdown of facilities for at least one week

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.10	High

3.2.11 Land Subsidence

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.

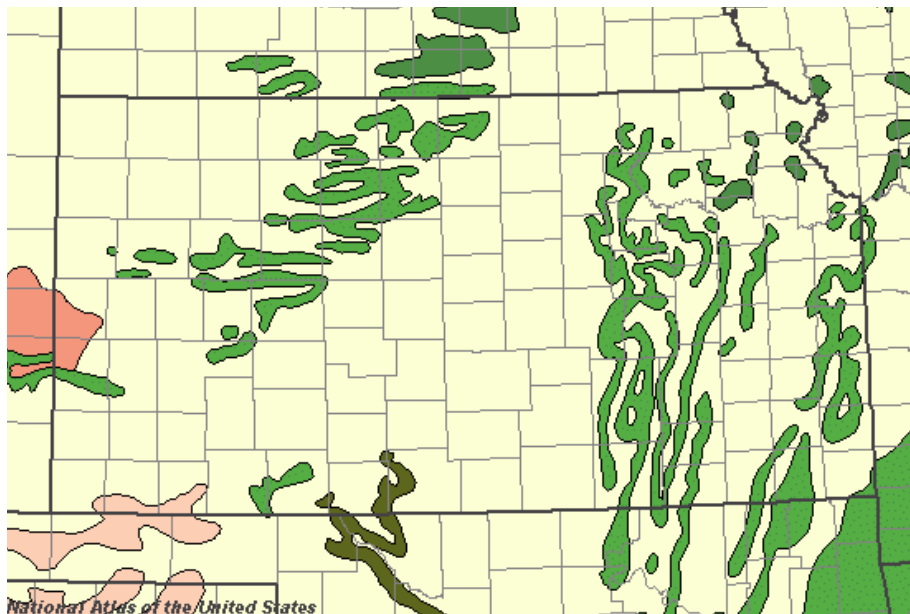
Warning Time: Level 4 Less than 6 hours

Duration: Level 4 More than 1 week

Geographic Location

There are limited documented problems associated with limestone subsidence and sinkholes in Kansas. Figure 3.12 illustrates the location of karst features in Kansas. The green areas shown in the map, which occur in northwest Douglas County, show fissures, tubes, and caves generally less than 1,000 feet (ft) long with 50 ft 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 ft or more in areas of subsidence from piping in thick unconsolidated material. Darker pink areas contain fissures and voids to a depth of 50 ft.

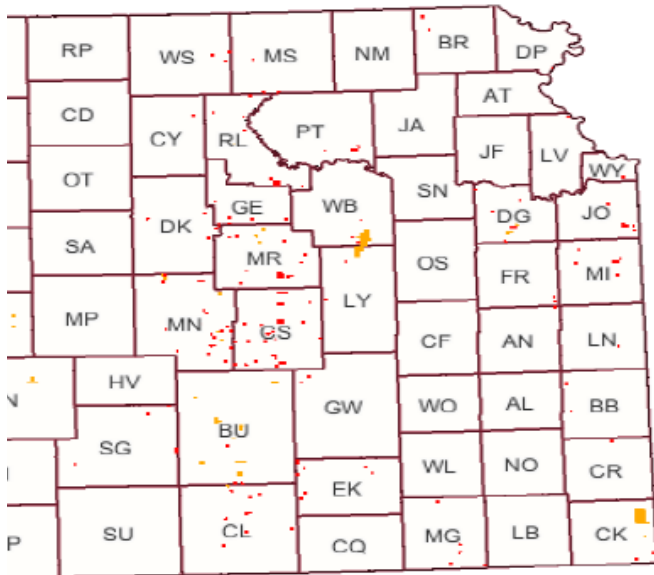
Figure 3.12 Karst Features in Kansas



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

Figure 3.13 shows one-mile square sections of land in the eastern half of Kansas where sinkhole locations have been documented. There are several one-mile square sections of land in Douglas County where sinkholes have been documented. Sections in red indicate sinkhole occurrences (yellow indicates springs).

Figure 3.13 Sinkholes in Eastern Kansas



Source: Kansas Geological Survey

In 2006, the Kansas Department of Health and Environment prepared a report on “Subsurface Void Space and Sinkhole/Subsidence Area Inventory for the State of Kansas.” This report inventoried subsurface void space from oil and gas exploration and production, natural sources, shaft mining and solution mining. According to this report, there are none of these particular subsurface void spaces in Douglas County.

Previous Occurrences

According to the Kansas Geological Survey, there have been several documented sinkholes in Douglas County. However, the HMPC did not have additional information regarding the locations or any associated damages of these events.

Probability of Future Occurrences

The HMPC determined that although subsidence incidents have reportedly occurred, subsidence does not occur often as this hazard is not generally considered to be particularly significant in the planning area.

Unlikely: Level 1 Event is possible in the next 10 years

Magnitude/Severity

Although this hazard occurs occasionally, the HMPC is unaware of any associated damages. Therefore, the magnitude is considered “negligible”.

Negligible: Level 1 Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours

Hazard Summary

Calculated Priority Risk Index	Planning Significance
1.75	Low

3.2.12 Landslide

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.

Warning Time: Level 3 6-12 hours

Duration: Level 1 Less than six hours

Geographic Location

There are only four high cuestas or summits in Douglas County (See Table 3.13).

Table 3.13 High Cuestas of Douglas County

Feature	Type	County	USGS Topo Map	Elevation	Lat	Long
Blue Mound	Summit	Douglas	Lawrence East	1043 feet	38.904 N	95.182 W
Coon Point	Summit	Douglas	Perry	1109 feet	39.007 N	95.426 W
Shank Hill	Summit	Douglas	Lawrence West	997 feet	38.889 N	95.262 W
Twin Mounds	Summit	Douglas	Globe	1036 feet	38.861 N	95.491 W

Previous Occurrences

There are no records of previous occurrences of landslide in the Douglas County planning region.

Probability of Future Occurrences

Landslides are possible in Douglas County. However based on the infrequency of previous occurrences, this hazard was considered unlikely by the HMPC.

Unlikely: Level 1 Event is possible within the next ten years

Magnitude/Severity

Negligible: Level 1 Less than 10 percent of property severely damaged; shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Hazard Summary

Calculated Priority Risk Index	Planning Significance
1.30	Low

3.2.13 Lightning

Description

Severe thunderstorms strike Kansas on a regular basis with high winds, heavy rains, and the occasional subsequent flooding, often accompanied by lightning. Lightning is an electrical discharge between positive and negative regions of a thunderstorm. It is sudden, extremely destructive and potentially deadly. The NWS reports that lightning caused 48 fatalities and 246 injuries nationwide in 2006 and causes 73 fatalities and 300 injuries in an average year.

The National Lightning Safety Institute reports that lightning causes more than 26,000 fires in the United States each year. The institute estimates that the total cost for direct and indirect impacts of lightning including property damage, increased operating costs, production delays, and lost revenue to be in excess of \$6 billion per year.

Due to its nature as a powerful electrical phenomenon, lightning causes extensive damage to electronic systems that it contacts. A particular concern in Kansas is the protection of facilities and communications systems that are critical for maintaining emergency response systems, protecting public health, and maintaining the state's economy. The threat to communications systems includes tornado sirens, which could get knocked out just when they are needed most.

Average duration of each lightning stroke is 30 microseconds and overall duration of lightning storm events is usually less than six hours.

Warning Time: Level 2 12-24 hours

Duration: Level 1 Less than 6 hours

Geographic Location

The entire planning area, including all participating jurisdictions, is at risk to lightning.

Figures 3.14 and 3.15 show Douglas County located in an area with an average of 30-70 days with thunderstorms per year per 10,000 square miles (part of the county is shaded dark green and

part of the county is shaded medium green) and four to eight lightning strikes per square kilometer per year (orange shaded area).

Figure 3.14 Distribution and Frequency of Thunderstorms

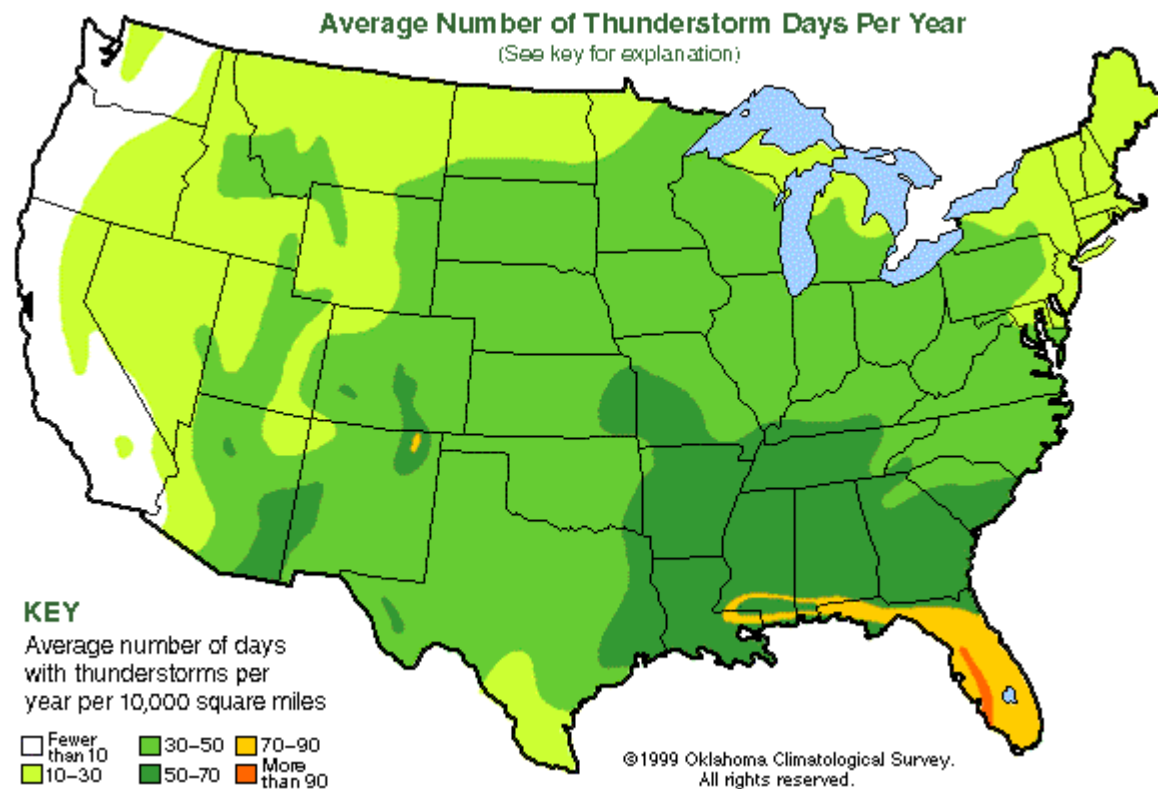
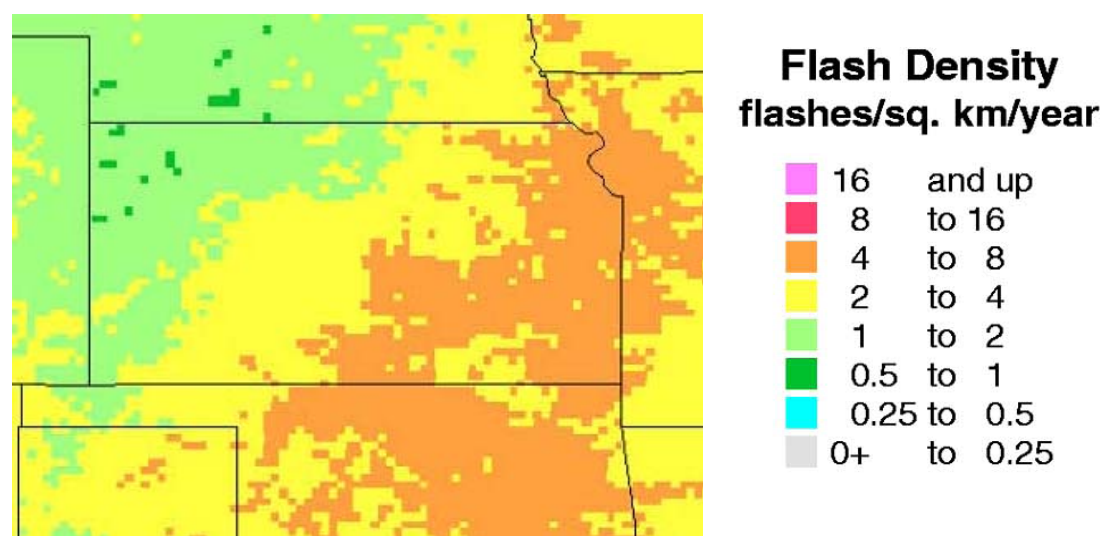


Figure 3.15 Location and Frequency of Lightning in Kansas



Source: National Weather Service, www.lightningsafety.noaa.gov/lightning_map.htm

Previous Occurrences

The NCDC database has record of 29 damaging lightning events in Douglas County from 1993 to October 2007. These events caused an estimated \$284,000 in property damages.

- **6/15/1991:** A fire started by lightning in Hoch Auditorium on the Kansas University campus around 3:20 p.m., shortly after a violent thunderstorm began pelting the Lawrence area with heavy rain and pea-sized hail. By 7 p.m., over 70 firefighters from Lawrence and such nearby cities as Lenexa, Overland Park, and Shawnee were finally able to contain the fire, but not before it had collapsed the roof, gutted the entire structure, and left little more than charred, smoking remains. “It was a total loss,” said KU Police Lt. John Mullens. In a little under four hours, one of KU’s oldest and most revered buildings – one of six on campus listed in the National Register of Historic Places – was gone. Notwithstanding the estimated \$13 million in material damage, the fire destroyed irreplaceable archival materials belonging to the University’s FM radio station, KANU, and displaced thousands of students and faculty scheduled to attend or teach fall semester classes in Hoch.
- **8/23/2004:** Lightning struck a wastewater treatment plant in Lawrence and damaged a number of controls. Total property damage was estimated at \$6,000.
- **6/4/2002:** Lightning struck a radio station and started a fire that destroyed some equipment.
- **8/23/1994, 6/2/2003, 4/10/2001, 9/11/2000, 6/28/1999, 9/21/1998, 3/24/1997, 10/10/1996, and 6/6/1994:** On each of these dates, a home or business was struck by lightning and a fire started that caused significant damage.

Probability of Future Occurrences

Douglas County is in the region determined by the NWS to receive four to eight lightning strikes per square kilometer per year. Based on the history of house and business fires started by lightning strikes, the HMPC determined the probability of future occurrences to be highly likely in any given year.

Highly Likely: Level 4 – Event is possible within the next calendar year

Magnitude/Severity

Although the frequency of lightning events is quite high, the magnitude is negligible. Generally damages are limited to single buildings and in most cases, personal hazard insurance covers any losses.

Limited: Level 2 – 10% to 25% of property severely damaged

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.80	Moderate

3.2.14 Soil Erosion and Dust

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.

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 percent of the incidence of asthma is related to dust. Blowing dust can be severe enough to necessitate highway closures because of low visibility, which can cause vehicle accidents.

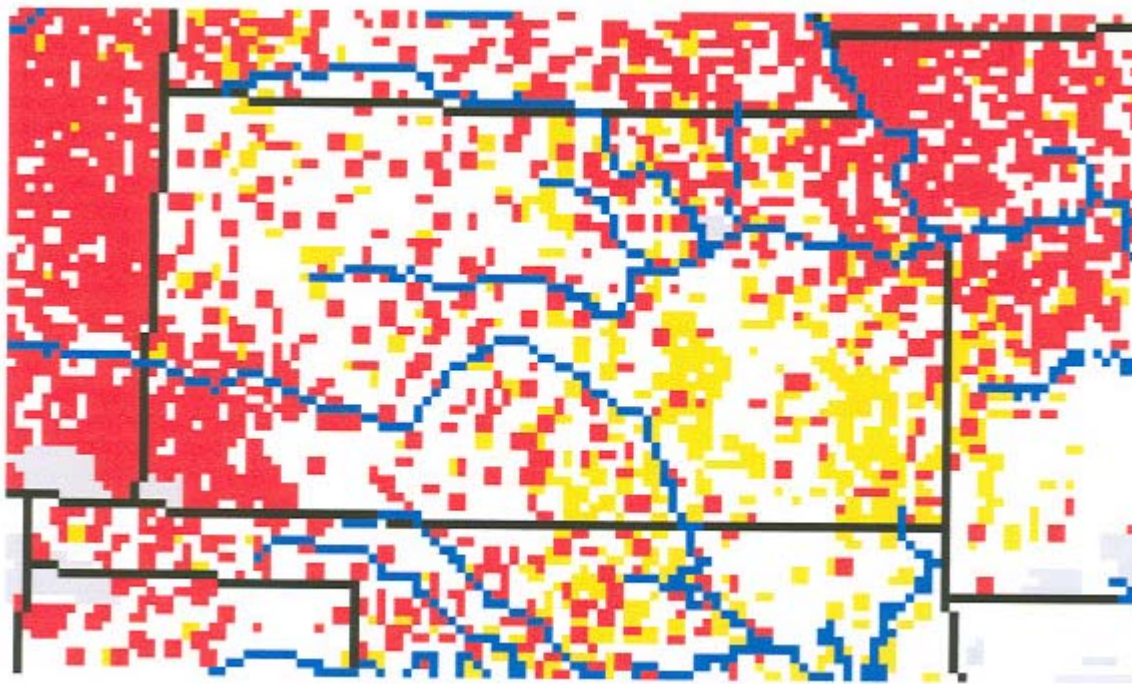
Warning Time: Level 1 More than 24 hours

Duration: Level 4 More than one week

Geographic Location

Figure 3.16 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 non-highly erodible land with excessive erosion above the tolerable soil erosion rate. Douglas County and the northeast portion of Kansas have highly erodible land. However, it appears that Douglas County does have some sections of land that are considered non-highly erodible.

Figure 3.16 Locations of Excessive Erosion of Farmland, 1997



Previous Occurrences

There were no specific dust storm events listed in the NCDC database. Previous occurrences of notable soil erosion in the planning area have occurred during flood events.

Probability of Future Occurrences

While soil erosion and dust occur annually as part of natural processes, the adverse effects of erosion are only fully realized as a cumulative function. The HMPC determined the probability of notable cumulative effects from soil erosion and dust events to be on the average every ten years.

Unlikely: Level 1 Event is possible within the next ten years

Magnitude/Severity

With a portion of the economy dependent on nutrients in topsoil, the cumulative effects over time from soil erosion have a negative impact on the planning area. In addition, erosion as a result of floodwater can cause significant damage to bridge footings and roads.

Limited: Level 2 10% to 25% of property severely damaged

Hazard Summary

Calculated Priority Risk Index	Planning Significance
1.60	Low

3.2.15 Tornado

Description

The NWS 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 1 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 the Windstorm section.

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 formation of tornado funnels. In Kansas, most tornadoes and tornado-related deaths and injuries occur during the months of April, May, and June.

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) 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, 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 3.14 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 3.15 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 3.14 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 3.15 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

Warning Time: Level 4 Typical warning time is less than six hours

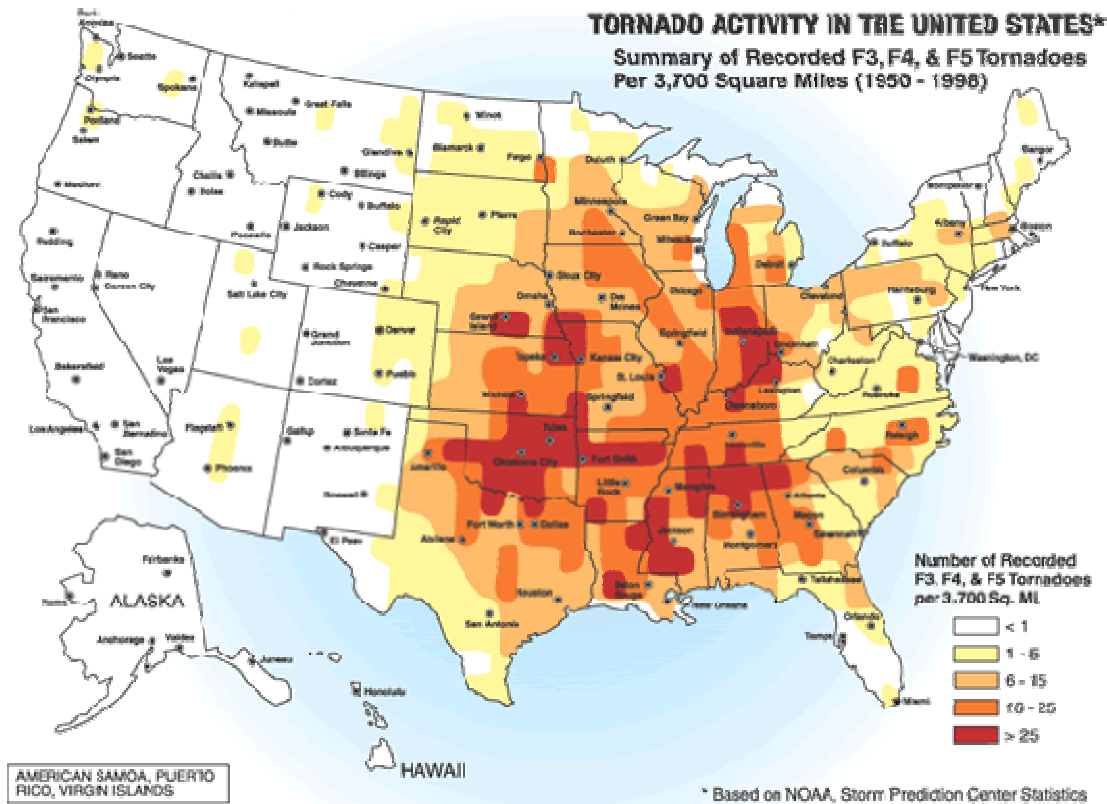
Duration: Level 1 Less than six hours

Geographic Location

While tornadoes can occur in all areas of the State of Kansas, historically, some areas of the state have been more susceptible to this type of damaging storm. Figure 3.17 illustrates the number of F3, F4, and F5 tornadoes recorded in the United States per 3,700 square miles between 1950 and

1998. Douglas County, Kansas is in the sections shaded dark orange, indicating 16-25 tornadoes of this magnitude during this 48-year period, and red, indicating 25 or more tornadoes of this magnitude during the period. All of Douglas County, including all of the participating jurisdictions, is at risk to tornadoes.

Figure 3.17 Tornado Activity in the United States



Previous Occurrences

According to the NCDC database, there were 31 tornadoes in Douglas County, Kansas between 1950 and 2008. Of these, nine (9) were rated F0, ten (10) were rated F1, seven (7) were rated F2, four (4) were rated F3, and one (1) was rated F4. Total personal property damage was estimated at \$39,025,000 and crop damage was estimated at \$90,000. There was 1 death and 47 injuries reported during this time period. Table 3.16 summarizes these events:

Table 3.16 Recorded Tornadoes in Douglas County, 1950-2008.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property Damage	Crop Damage
1 DOUGLAS	06/08/1951	1700	Tornado	F2	0	0	3K	0
2 DOUGLAS	05/22/1952	1710	Tornado	F4	0	2	250K	0
3 DOUGLAS	07/07/1956	2200	Tornado	F1	0	0	3K	0
4 DOUGLAS	06/11/1957	1800	Tornado	F2	0	0	0K	0
5 DOUGLAS	11/17/1958	1110	Tornado	F1	0	0	0K	0

Location or County	Date	Time	Type	Mag	Dth	Inj	Property Damage	Crop Damage
6 DOUGLAS	07/11/1962	2220	Tornado	F2	0	0	3K	0
7 DOUGLAS	08/06/1962	1900	Tornado	F3	0	0	250K	0
8 DOUGLAS	08/06/1962	1940	Tornado	F1	0	0	0K	0
9 DOUGLAS	08/06/1962	1940	Tornado	F1	0	0	0K	0
10 DOUGLAS	04/02/1964	1800	Tornado	F1	0	0	0K	0
11 DOUGLAS	04/12/1964	1526	Tornado	F3	0	3	2.5M	0
12 DOUGLAS	06/12/1966	1601	Tornado	F1	0	0	0K	0
13 DOUGLAS	07/09/1969	1650	Tornado	F2	0	2	250K	0
14 DOUGLAS	05/04/1977	1805	Tornado	F3	0	1	2.5M	0
15 DOUGLAS	05/31/1980	1635	Tornado	F2	0	0	250K	0
16 DOUGLAS	06/19/1981	1830	Tornado	F3	1	33	25.0M	0
17 DOUGLAS	06/02/1989	1730	Tornado	F0	0	0	0K	0
18 DOUGLAS	03/12/1990	2358	Tornado	F1	0	0	250K	0
19 DOUGLAS	03/01/1991	1645	Tornado	F0	0	0	25K	0
20 DOUGLAS	06/15/1991	1430	Tornado	F0	0	0	3K	0
21 Pleasant Grove	05/06/1993	1845	Tornado	F0	0	0	0	0
22 Lawrence	09/21/1993	1440	Tornado	F0	0	0	0	0
23 Lawrence	09/21/1993	1520	Tornado	F0	0	0	5K	0
24 Baldwin City	05/16/1995	2030	Tornado	F1	0	0	1.0M	90K
25 Lawrence	10/04/1998	1705	Tornado	F1	0	0	75K	0
26 Globe	05/08/2003	1817	Tornado	F0	0	0	0	0
27 Lone Star	05/08/2003	1826	Tornado	F1	0	0	0	0
28 Lawrence	05/08/2003	1838	Tornado	F2	0	6	6.4M	0
29 Lone Star	08/23/2004	1939	Tornado	F0	0	0	0	0
30 Clinton	03/30/2007	2139	Tornado	F0	0	0	0K	0K
31 Clinton	05/02/2008	0004	Tornado	F2	0	0	260K	0K
TOTALS:					1	47	39.025M	90K

Douglas County has been included in nine (9) Presidential Disaster Declarations that included tornado damage. Listed below are some descriptions of specific tornadoes from the NCDC database:

- **5/16/1995:** A small tornado formed along the north edge of a strong downburst and moved mainly across open fields. The tornado skipped across the county destroying several farm buildings, a motor home and farm equipment. However, with widespread straight line wind damage in the area, it was difficult to distinguish between the cause(s) of the damage. The most significant damage occurred along and about one to two miles west of Highway 33. Property damage estimated topped \$1,000,000 and crop damage estimates were \$90,000.
- **5/8/2003:** A tornado touched down in the southwest part of Lawrence and did considerable damage to the area. An apartment complex suffered major damage as did several other homes and residences in the area. Six people were injured and treated at a Lawrence hospital. Severe weather erupted over a large part of the area during the afternoon and evening hours of the 8th. Numerous reports of large hail and a few reports of strong winds were received May 8, 2003, was estimated to be the most significant and widespread tornado outbreak in northeast Kansas since April 26, 1991. All meteorological severe weather forecast parameters came together over northeast Kansas on the afternoon of May 8 to produce a

Storm Prediction Center (SPC) "high risk" area of potential severe weather. The possibility of strong, long-lived destructive tornadoes was highlighted for nearly 24 hours in advance in nearly every NWS statement and product. The significant and widespread tornado outbreak in the nearby Kansas City area just four days before increased public weather awareness and concern, and together with timely watches, statements and warnings, helped prevent tornado related deaths and minimized storm injuries. There were 6 injuries reported with this storm and estimated damages were reportedly \$6,400,000.

Probability of Future Occurrences

Based on the previous recorded history of 31 tornadoes in a 57-year period, there is a 54 percent probability of a tornado in Douglas County in any given year. This, along with the location of Douglas County in Wind Zone IV, makes the probability of a tornado in any given year likely.

Likely: Level 3 Event is probable within the next three years

Magnitude/Severity

Eleven of the 31 reported tornado events in Douglas County or 35% have caused widespread damage resulting in at least a quarter of a million dollars in damages. Five events have caused damages in the millions, including an F3 tornado in 1981 that caused \$25,000,000 in property damage. The potential for a strong, damaging event certainly exists considering the location of Douglas County in Wind Zone IV. The HMPC has determined that the worst-case scenario should be considered for mitigation planning purposes. In Douglas County, the worst-case scenario tornado event would be an EF-5 rated tornado striking one of the more populated cities in the planning area.

Catastrophic: Level 4 More than 50 percent of property severely damaged; shutdown of facilities for 30 days or more; and/or multiple deaths.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.25	High

3.2.16 Utility/Infrastructure Failure

Description

Utilities and infrastructure involve several different types of facilities and systems: transportation, power systems, natural gas and oil pipelines, water and sewer systems, electric power production and distribution systems and telecommunications facilities. Failure of utilities or other components of the infrastructure in Douglas County could seriously impact the functioning of communities, and the area'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 and electric systems are vulnerable to the ice storms that are prevalent in northeastern Kansas).

Warning Time: Level 4 Less than 6 hours

Duration: Level 4 More than one week

Geographic Location

Although the entire geographic area is subject to utility failures, rural areas are more susceptible to power outages lasting more than one week. The Kaw Valley Rural Electric Cooperative provides electric service into six counties in northeast Kansas, including rural western Douglas County. The cooperative has 8,000 residential services and over 1,500 miles of distribution line.

Previous Occurrences

Many service disruptions have been experienced over past years. The disruptions are generally related to hazardous weather conditions such as ice, snow, wind and tornado. In December 2007, a severe ice storm placed most of northeast Kansas in a situation of being without electric power and some communities without telephone service. An article in the December 13, 2007 Topeka Capital Journal quotes county officials as saying "Westar Energy, Bluestem Electric and other utility companies are reporting seven to 10 days minimum until power is fully restored. Maximum estimates are as high as two weeks, creating a timeline of anywhere between Dec. 19 and 26."

On March 3, 2006, a storm struck Lawrence at approximately 8 a.m. on Sunday with what originally was thought to be a tornado. Later, it was determined to have been a "microburst" of high winds. This storm provides an example of the crippling effect that widespread power outage can have on a metropolitan area. Two storm-related injuries were reported and approximately 17,000 customers were without power in Lawrence. As of Sunday evening, 6,000 were still without power. The University of Kansas reported some damage to approximately 60 percent of the buildings on campus, including Robinson, Murphy, Fraser, Malott and Green halls; Anschutz Library; Haworth residence hall; the Chancellor's residence and geological survey building. The most significant damage was to Robinson and Murphy halls, which both sustained moderate roof damage. Other damages across the campus included windows and rooftop air conditioning units.

There was a complete loss of power to the campus and all Monday classes were cancelled. The American Red Cross opened a shelter at the First Baptist Church for approximately five hours and three families were housed in motels for the night. (Source: Kansas Adjutant General's Office, Press Release # 06-030, 3/13/2006)

Probability of Future Occurrences

Because of the frequency of winter storms and the association of these storms with loss of electric power, the HMPC determined the probability of future occurrences to be highly likely.

Highly Likely: Level 4 Event is probable within the calendar year

Magnitude and Severity

Critical: Level 3 Complete shutdown of critical facilities, 25% to 50% of property severely damaged

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.70	High

3.2.17 Wildfire

Description

Wildfires in Kansas typically originate in pasture or prairie areas following the ignition of dry grasses (by natural or human sources). About 75 percent of Kansas wildfires start during spring due to 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.

Warning Time: Level 4 Less than six hours

Duration: Level 3 Less than one week

Geographic Location

In September 2008, the Kansas Forest Service conducted a Community Wildfire Hazard Assessment Report for Douglas County. In the report, the areas surrounding Eudora, Lawrence, and Lecompton qualified as low hazard areas. The Stull area was assigned a moderate hazard rating due to heavier fuel loads of hardwood timber, grass, and eastern red cedar mix that has little or no break in the fuel continuity. The areas near Clinton Lake, Kanwaka, and Wakarusa were assigned a high hazard risk. This risk was assigned to these Douglas County communities due to the greater slopes, heavier concentrations of tall grass and evergreen (cedar) timber fuels, and lots with little to no defensive clearance. A copy of the Community Wildfire Hazard Assessment Report is included in Appendix E.

Previous Occurrences

According to the Special Kansas Fire Loss Summary-2006 Kansas State University Wildland Report, Douglas County had 186 fires burning a total of 1,009 acres in 2006. The reported damages from these fires totaled \$779,630. One civilian injury was reported to have been associated with these rural fires. Wildfire does occur on an annual basis in Douglas County, and as these fires encroach on residential areas, losses increase.

Probability of Future Occurrences

In Douglas County, there has been a development trend involving construction of residential dwellings in pasture areas or rural areas that are more prone to wildfire damage. Future occurrences of this hazard are likely to increase if development in wildland-urban interface areas increases.

Likely: Level 3 Event is probable within the next three years

Magnitude/Severity

Wildfires occur on an annual basis, most do not result in significant threat to life or property. The HMPC felt that the potential for increased severity due to residential development placed the severity for this hazard at limited.

Limited: Level 2 10% to 25% of property is severely damaged, shutdown of facilities and services for more than one week, and/or injuries/illnesses do not result in permanent disability.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
2.85	Moderate

3.2.18 Windstorm

Description

Relatively frequent strong winds are a weather characteristic of Kansas. Kansas is located within Wind Zones III and IV, the highest inland categories. All of Douglas County is in Wind Zone IV. 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. 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.

Warning Time: Level 4 Less than 6 hours

Duration: Level 2 Less than one day

Geographic Location

All of Douglas County is susceptible to high wind events. It is located in Wind Zone IV, which is susceptible to winds up to 250 mph. All of the participating jurisdictions are vulnerable to this hazard.

Previous Occurrences

According to the NCDC database, there were 184 wind events involving Douglas County between 1955 and 2008, excluding events between October 1 and March 1. During this time period there were no reported deaths but 8 injuries as a result of windstorm events. Total property damage for events between 1993 and 2007 was estimated at \$14,644,000 and crop damage at \$617,000.

Descriptions of some of the more notable events are provided below:

-
- **7/1/1994:** Very high winds, initially estimated at 110 mph, caused significant damage to campers, tents, RVs, some buildings and the marina/dock area in the Clinton State Park. One young boy was hit by flying debris and required several stitches to close the cut on his head. During the same storm, winds estimated to near 80 mph caused widespread tree, power line and structural damage in and around the city of Lawrence. Most of the city was without power for several hours. Damages from the storm were estimated at \$550,000.
 - **5/16/1995:** A 1.5 mile wide swath of very strong straight-line or downburst winds moved west to east across the southern section of the county, just south of US Highway 56. Numerous homes, buildings, farms and barns reported varying degrees of damage. Crops in the area were also damaged or destroyed. This supercell storm also produced a brief tornado near Baldwin City. Damages were estimated at \$1,800,000 in property damage and \$100,000 in crop damage.
 - **4/11/2001:** Strong winds associated with an intense low pressure system reached speeds over 80 mph at times and did extensive damage over the area that was estimated in the millions of dollars. Most of the damage occurred to homes, power lines and businesses. Windows were blown out of many homes across the area. Large trees were severely damaged and vehicles were overturned on area roads. Three semi tractor trailers were overturned on Interstate 70 between Topeka and Maple Hill. A semi was overturned on Interstate 70 13 miles east of Junction City along with several other vehicles. Power outages occurred from downed power lines. It was the worst windstorm over a widespread area in many years. Property damages were estimated at \$4,000,000.
 - **6/12/2004:** Strong winds moved across northern Douglas County doing considerable damage. A stock trailer was overturned near Lecompton, and considerable tree limb and power line damage occurred in Lawrence. Crops suffered considerable damage as well. Property damage was estimated at \$10,000 and crop damage at \$10,000.
 - **3/12/2006:** A large portion of the City of Lawrence sustained damage. The governor issued a State of Disaster Emergency for Douglas County. At least three direct storm related injuries were reported. Windows were blown out of numerous cars and businesses. A trailer park also sustained damage. Numerous telephone poles and trees were blown down. Many trees and cars on the Kansas University campus were damaged. More than 70 of Kansas University's 116 buildings received some damage. Many homes in the city also sustained damage. Video of the event indicated a microburst with winds of 70 to 90 mph. Several notable events reflected the severity of the wind damage. A heating/cooling unit was blown from the roof of a campus residence hall and landed on a car. Several semi-trucks were blown onto their sides. Two brick spires were toppled from one of the city's oldest churches dating back to 1870. Two 60 foot tall silos at a country market near Lawrence were destroyed. Three 500 pound ventilators atop a junior high building were blown off the roof, one landing nearly 100 yards away. Each ventilator was 6 feet tall and 5 feet wide. The emergency manager of Douglas County estimated total damage at 8 million dollars of which 6 million dollars occurred on the Kansas University campus alone. The storm caused significant roof and window damage and cost the University approximately \$6.607 million in repairs. The University was closed for classes for one day.

Probability of Future Occurrences

According to NCDC, there were 184 wind events (excluding events from October 1 through March 1 and those associated with winter storms) in Douglas County between 1955 and 2008 (55 years). Based on this information, the probability that at least one wind event will occur in the county in any given year is 100 percent. This hazard's annual probability is highly likely.

Highly Likely: Level 4 Event is probable within the next calendar year.

Magnitude/Severity

Critical: Level 3 25% to 50% of property is severely damaged, shutdown of facilities and services for at least two weeks, and/or injuries/illnesses result in permanent disability.

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.50	High

3.2.19 Winter Storm

Description

Winter storms in Douglas County usually come in the form of heavy snow or freezing rain (ice storms). Regardless of the form they take, they result in significant impacts to the county 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 concern Douglas County residents.

A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The NWS 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.

While ice storms generally are of more concern than snow storms due to the increased potential for power outage, snow storms do cause problems in Douglas County when significant snowfall drifts due to high winds.

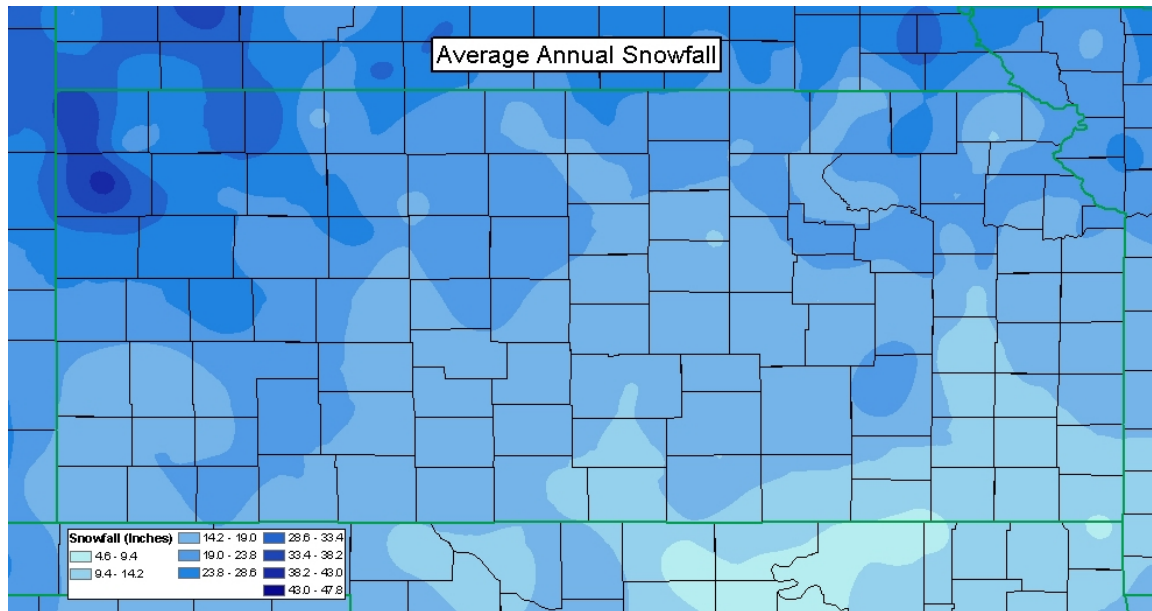
Warning Time: Level 2 12 to 24 hours

Duration: Level 4 More than one week

Geographic Location

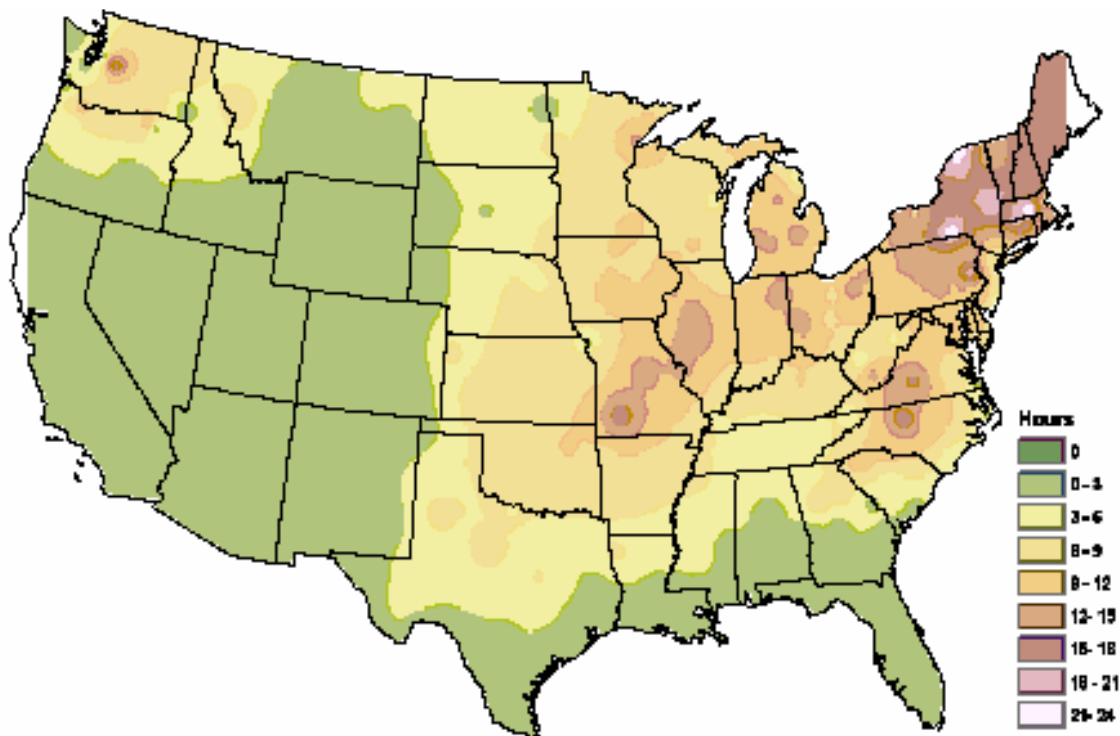
All of Douglas County is vulnerable to heavy snow and freezing rain. Northeast Kansas, including Douglas County, receives a moderate amount of snowfall (see Figure 3.18) between 14.2 and 19.0 inches of snowfall annually. Freezing rains also occur frequently in northeastern Kansas (see Figure 3.19). In this figure, Douglas County is shown to spend between 8-9 hours per year with freezing rain.

Figure 3.18 Average Annual Snowfall



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

Figure 3.19 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>.

Previous Occurrences

As detailed in Table 3.17, Douglas County has received 2 Presidential Disaster Declarations for winter-type storms and 3 United States Department of Agriculture (USDA) declarations for winter-type storms.

Table 3.17 Disaster Declarations in Douglas County Including Winter Storm

Declaration Number	Declaration Date	Disaster Description	Counties Involved	Constant 2006
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
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
S2525	4/4/2007	Excessive Heat, Winter Storms	Douglas	n/a
S2128	1/1/2005	Drought, High Winds, Excessive Heat, Winter Storms	Douglas	n/a
M1579	1/4/2005	Winter Storms, Excessive Moisture	Douglas	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.				

FEMA-1402-DR, Ice Storm, February 6, 2002 (January 29-February 15)

Beginning on January 29, 2002, 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. Public Assistance to Douglas County from FEMA for this storm amounted to \$808,593 and Individual Assistance from FEMA amounted to \$7,806 per records obtained from the Kansas Division of Emergency Management (KDEM) on 7/1/2008.

FEMA-1579-DR, Severe Winter Storms, Heavy Rains and Flooding, February 8, 2005 (January 4-6, 2005)

A widespread severe winter storm overspread north central, northeast and east central Kansas during the morning and afternoon hours of January 4, 2005. Freezing rain began about 10 AM over central Kansas and spread east and north during the afternoon, reaching the Missouri and Nebraska borders by about 4-5PM. Significant and heavy icing began to occur during the afternoon hours. The freezing rain changed to or mixed with sleet along and north of Interstate 70 during the evening of the 4th, and to heavy snow along Highway 36 from Belleville to Hiawatha, also during the evening. The freezing rain was heaviest and caused the most tree and property damage generally along and north of Interstate 35 from Emporia to Ottawa, and south of Interstate 70 from Lawrence to Topeka to Abilene. Snowfall amounts near the Nebraska border ranged from 3 to 6 inches. The counties of Osage, Lyon, Morris, southern Wabaunsee, southern Douglas and northern Franklin reported the most severe and widespread damage. Many areas particularly in the hardest hit counties experienced widespread tree damage and long-lasting power outages. An estimated 10,000 customers at one time were without power, with some outages in rural areas lasting for nearly a week. A total of 38 counties were covered in the Presidential Disaster Declaration. Public Assistance to Douglas County from FEMA for this storm amounted to \$193,077 per records obtained from the Kansas Division of Emergency Management (KDEM) on 7/1/2008. At Kansas University approximately 1 inch of ice was observed coating all surfaces. The storm brought down trees, limbs, power lines and damaged the roof of the Chancellor's residence. The University submitted claims to FEMA for \$29,495 for essential staff, equipment and landfill charges related to the clean-up from the storm. The University held no classes on the day following the ice storm. The University received \$18,162 in federal assistance and \$2,238 in state assistance.

In addition to the above events, NCDC records the following three notable winter storms in Douglas County between 1993 and 2007.

- **10/22/1996:** An early season winter storm produced a record breaking heavy wet snow in most of northeast and east central Kansas. Scattered thunderstorms locally enhanced the snowfall rates, causing amounts to vary greatly over short distances. The NWS at the Billard Airport in Topeka recorded 8.0 inches, which set a new twenty-four hour and monthly snowfall record for October. There were 8 inches of snowfall recorded in Lawrence. Since leaves still remained on many trees the stress from the weight of the snow on the leaves caused extensive damage to limbs which fell onto power lines and electrical transformers. The result was widespread power outages with more than 75,000 customers in northeast Kansas without power at the peak of the storm. The power company which services the

region estimated 2.5 million dollars of damage to its operations. The storm also contributed to numerous traffic accidents with over 100 confirmed in Topeka and Shawnee County and over 40 in Pottawatomie County. One fatal accident occurred on US Highway 40 in Douglas County 1 mile east of Big Springs when a car collided head-on with a semi-truck. Another fatal accident occurred in Osage County along the Kansas Turnpike 20 miles southwest of Topeka when a car struck the guard rail then another vehicle that was parked along the shoulder of the highway.

- **1/29/2002:** A major winter storm struck all of north central, northeast and east central Kansas in late January. Freezing rain mixed at times with sleet occurred across east central Kansas from the early evening of January 29 into the morning of January 31. The freezing rain accumulated as much as an inch and a half of glaze which caused considerable power line and tree damage. Many residents remained without power well into February. Several buildings collapsed under the weight of the ice doing considerable damage to the contents. A boat marina at Lake Perry collapsed under the weight of the ice and damaged or destroyed 19 boats. Northeast Kansas received mostly snow from the night of the 29th into the early afternoon of the 31st, although some sleet and freezing rain was mixed in at times. Many businesses, schools, colleges, and even the State Legislature were closed for several days because of the storm. Preliminary damage estimates were around 8 million dollars.
- **12/6/2007:** A mixture of freezing drizzle, sleet and snow created hazardous driving conditions throughout the county. Lawrence Police responded to twenty nine non-injury accidents and three injury accidents. A trained spotter reported that roadways were slick due to the mix of sleet and rain, followed by approximately 2 inches of snow. Douglas County sheriff's deputies responded to three non-injury accidents, two of which were on Interstate 70. A wintry mix of freezing rain, sleet, and snow fell across portions of northeast Kansas during the morning and early afternoon hours of December 6th. A thin coating of ice and sleet accumulated on elevated surfaces, vehicles, and some roadways mainly north of Interstate 70. Sites south of Interstate 70 generally saw the mixed precipitation continue through the morning hours. Several traffic accidents occurred as a result of the slippery roads and reduced visibilities where some of the heavier snow was reported.

Probability of Future Occurrences

During the 14-year period from 1993 to 2007, there have been 62 recorded winter storm events in Douglas County. Based on that history, there is an annual likelihood of 100 percent for winter storms. Thus the probability rating for winter storms in Douglas County is highly likely.

Highly Likely: Level 4 Event is probable within the next calendar year

Magnitude/Severity

Critical: Level 3 25% to 50% of property severely damaged; shutdown of facilities for at least two weeks

Hazard Summary

Calculated Priority Risk Index	Planning Significance
3.40	High

3.3 Vulnerability Assessment

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

3.3.1 Methodology

The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to natural hazards. The vulnerability assessment for this plan followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses* (2002).

The vulnerability assessment was conducted based on the best available data and the significance of the hazard. Data to support the vulnerability assessment was collected from the following sources:

- County and jurisdictional GIS data (hazards, base layers, and appraiser's data)
- Statewide GIS datasets compiled by state and federal agencies
- FEMA's HAZUS-MH loss estimation software
- Written descriptions of assets and risks provided by participating jurisdictions
- Existing plans and reports
- Personal interviews with HMPC members and other stakeholders

The vulnerability assessment first describes the assets at risk in Douglas County, including the total exposure of people and property; critical facilities and infrastructure; natural, cultural, and historic resources; and economic assets. Second, the assessment considers the social vulnerability of the County to hazards, including characteristics of gender, age, race/ethnicity, and wealth and poverty. Third, hazards of high and medium significance are evaluated in greater detail and potential losses are estimated where data is available. Development trends, including population growth, housing demand, and land use patterns, are analyzed in relation to hazard-prone areas. The end of the chapter summarizes the key issues and conclusions identified in the risk assessment process.

3.3.2 Assets at Risk

This section assesses the population, structures, critical facilities and infrastructure, and other important assets in Douglas County at risk to identified hazards.

Total Exposure of Population and Structures

Table 3.18 shows the estimated values for key building occupancies and Table 3.19 shows total population, number of structures, and assessed value of improvements to parcels in Douglas County. Land values have been purposely excluded because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Additionally, state and federal disaster assistance programs generally do not address loss of land or its associated value.

Table 3.18 Estimated Values for the Key Building Occupancies (Uses) for Douglas County (2005 Valuations)

Residential (000)	Commercial (000)	Industrial (000)	Agriculture (000)	Religion (000)	Government (000)	Education (000)	Total (000)
4,591,736	613,637	140,656	9,622	41,957	9,038	29,662	5,436,308

Source: Kansas Hazard Mitigation Plan November 2007

Table 3.19 Maximum Population and Building Exposure by Jurisdiction

Community	Population 2002	Number of Structures	Total Structure Value ()	Total Contents Value ()	Total Value ()
Lawrence	80,075	26,976	5,329,707,000	3,551,443,000	8,881,150,000
Eudora	4,243	1,968	242,317,000	144,491,000	386,808,000
Lecompton	604	298	30,196,000	17,911,000	48,107,000
Baldwin	3,400	1,605	226,790,000	142,771,000	369,561,000
Unincorporated Douglas County	11,640	6,332	791,104,000	491,760,000	1,282,864,000
Total	99,962	37,179	6,620,114,000	4,348,376,000	10,968,490,000

Sources: Kansas Division of the Budget (population); HAZUS-MH (MR 3) (structures)

Critical Facilities and Infrastructure

A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. FEMA's HAZUS-MH loss estimation software uses three categories of critical assets. Essential facilities are those that if damaged would have devastating impacts on disaster response and/or recovery, and high potential loss facilities are those that would have a high loss or impact on the community. Transportation and lifeline facilities are the third category of critical assets. Examples of each are provided below.

Essential Facilities

Hospitals and other medical facilities
Police stations
Fire stations
Emergency operations centers

High Potential Loss Facilities

Power plants
Dams and levees
Military installations
Hazardous material sites
Schools
Shelters
Day care centers
Nursing homes
Main government buildings

Transportation and Lifelines

Highways, bridges, and tunnels
Railroads and facilities
Airports
Water treatment facilities
Natural gas and oil facilities and pipelines
Communications facilities

Table 3.20 displays the inventory of critical facilities (based on available data) in Douglas County as provided HAZUS.

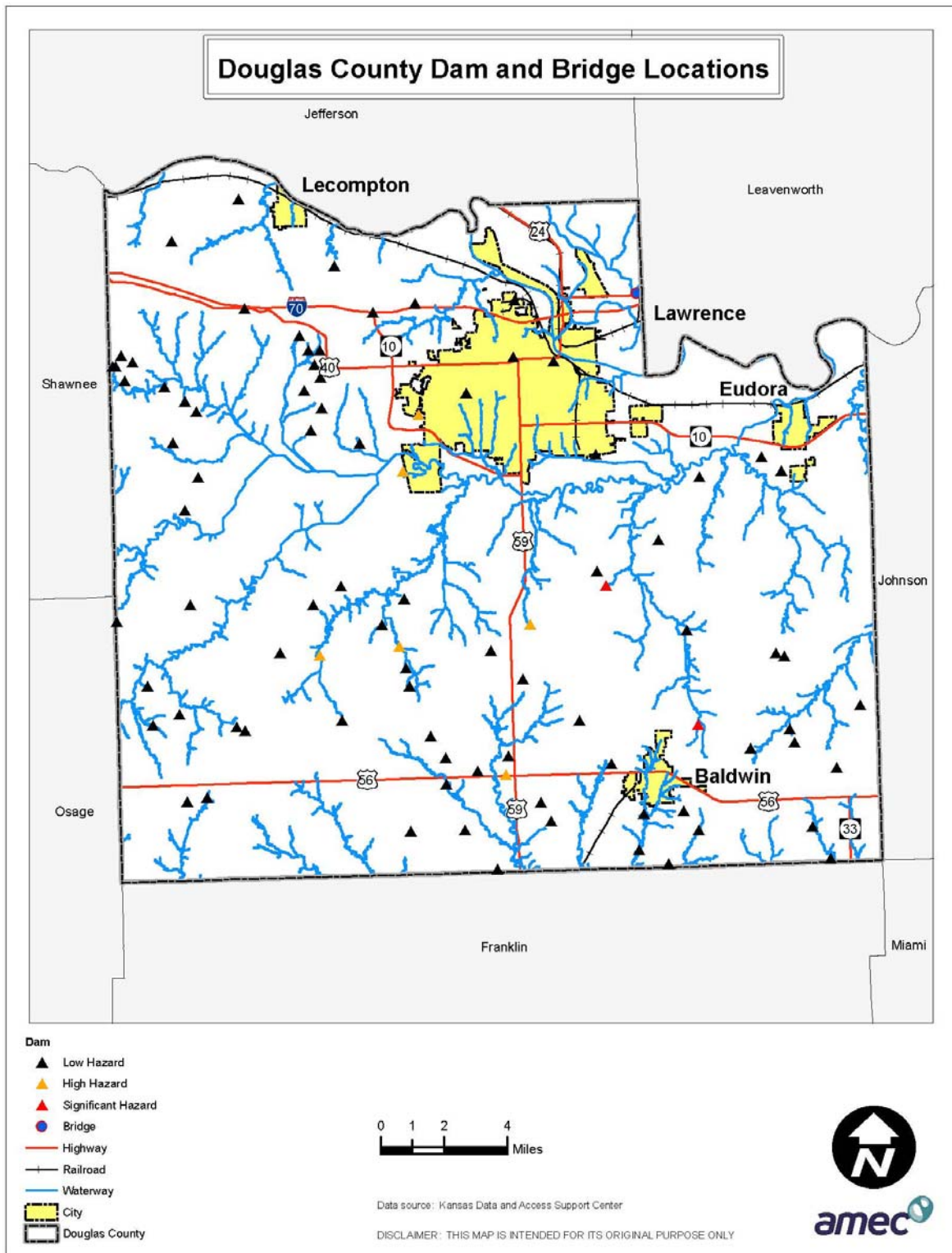
Table 3.20 Inventory of Critical Facilities and Infrastructure by Jurisdiction by Location

Facility	Unincorp. Douglas Co.	Baldwin	Eudora	Lawrence	Lecompton
Airports		1		1	
Colleges		1		5	
Dams low hazard	74			5	
Dams significant hazard	2				
Emergency medical services stations		1		6	
Fire stations		4	2	12	2
Health care facilities		1		13	
Power plants		2		2	
Schools		6	4	22	
Scour-critical bridges				1	
Totals	76	16	6	67	2

Source: HAZUS-MH (MR3)(Structures)

Figure 3.20 indicates the location of dams and bridges in Douglas County.

Figure 3.20 Dams and Bridges in Douglas County



Figures 3.21 through 3.24 indicate the location of critical infrastructure in each jurisdiction.

Figure 3.21 City of Baldwin City Critical Facilities

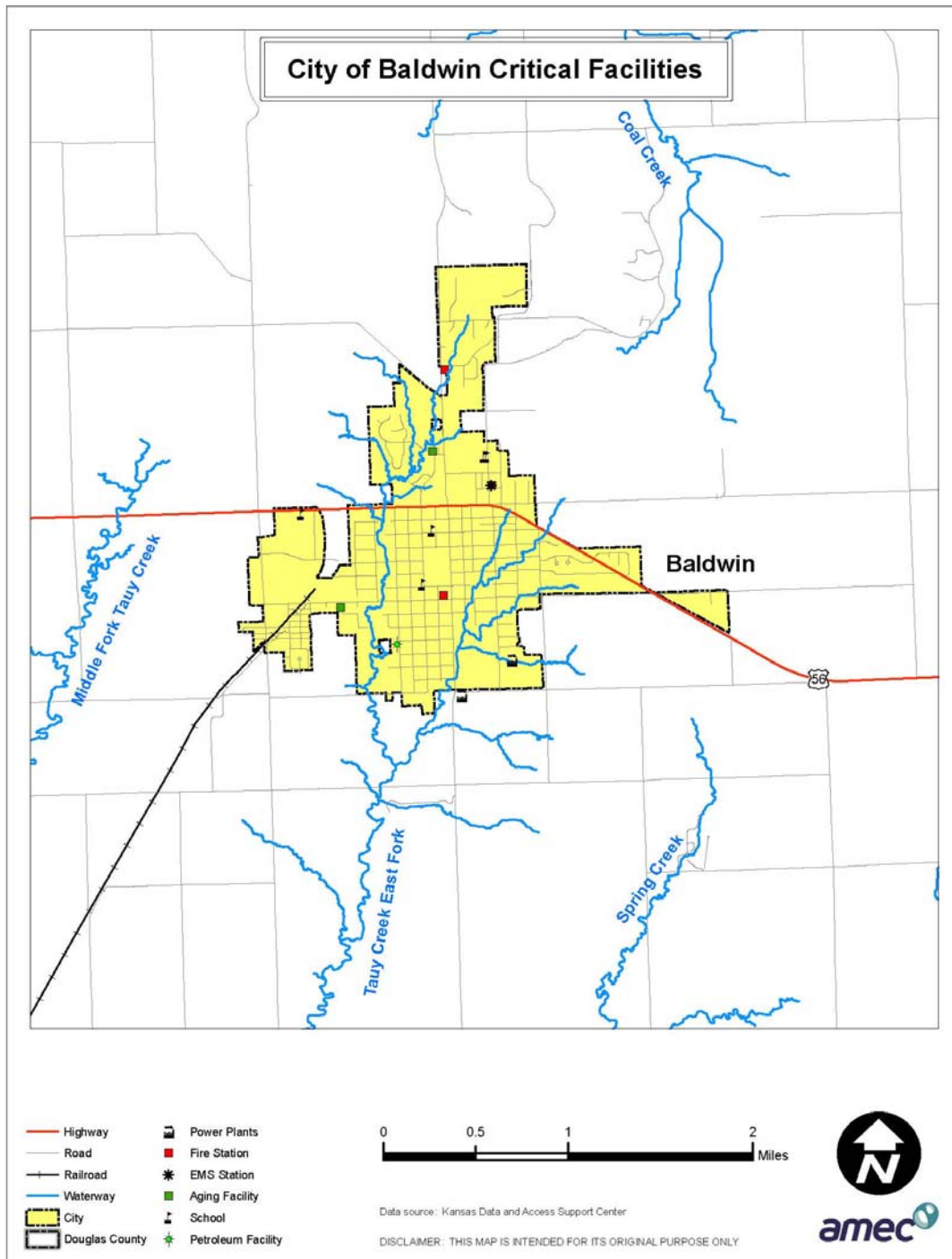


Table 3.22 City of Eudora Critical Facilities

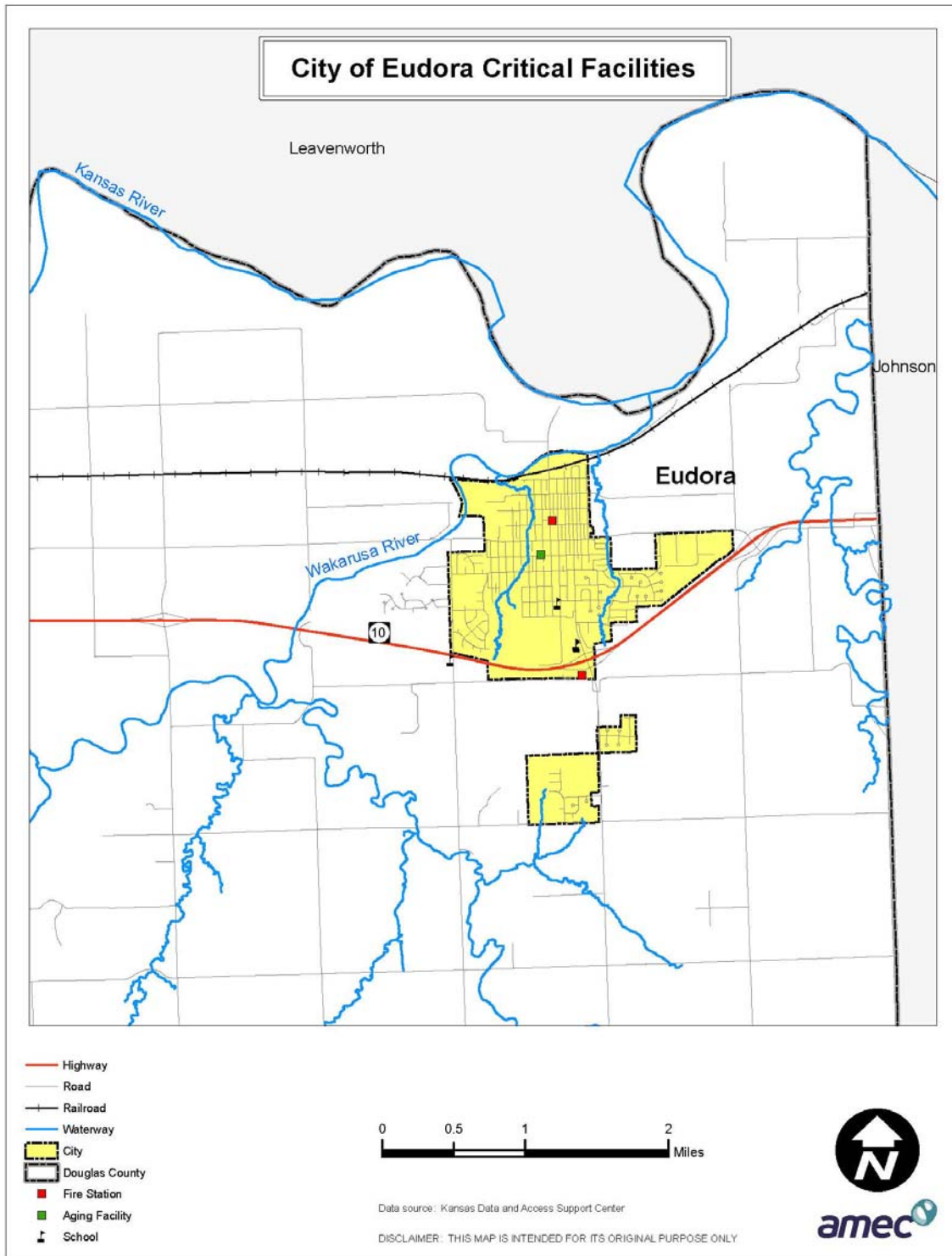


Figure 3.23 City of Lawrence Critical Facilities

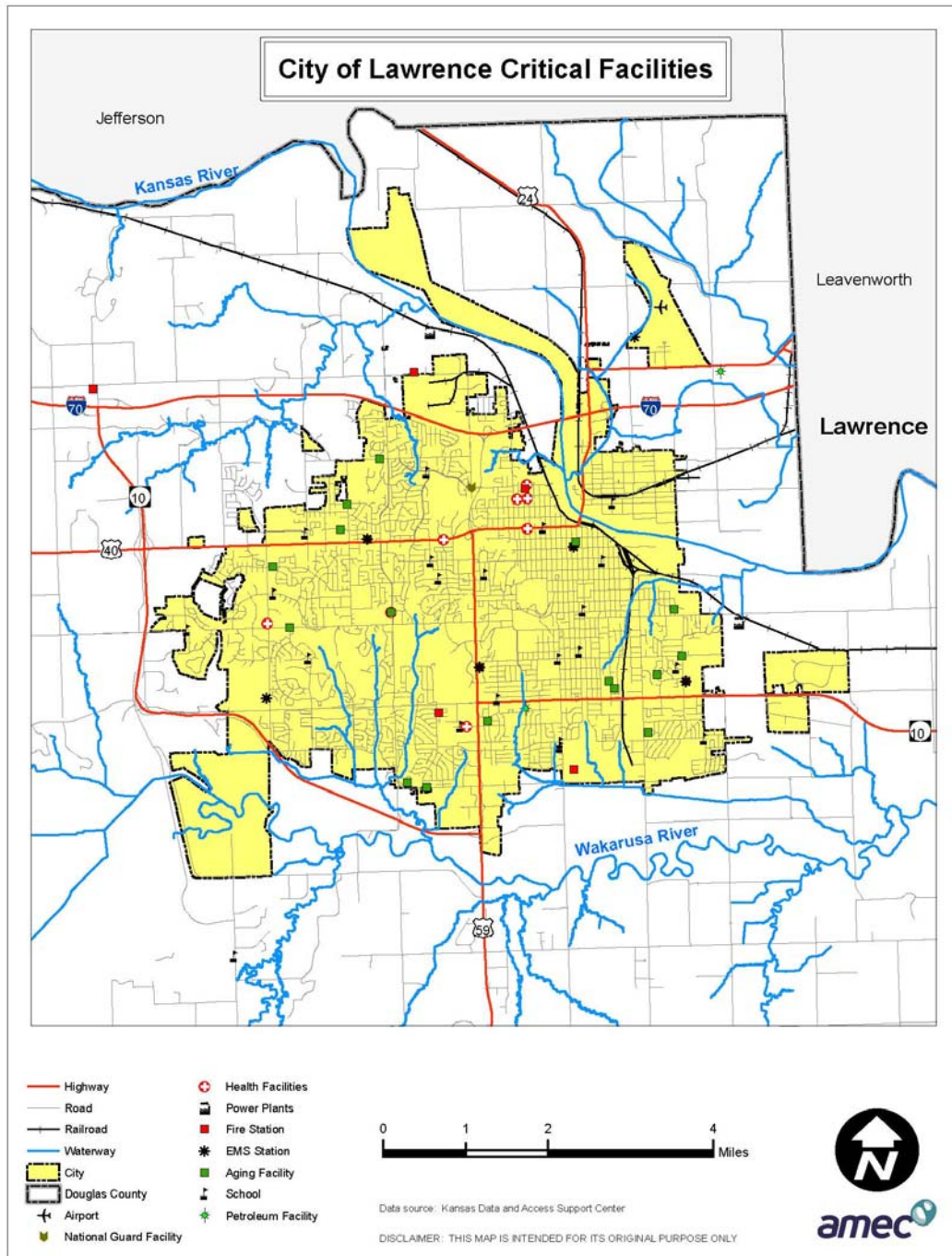
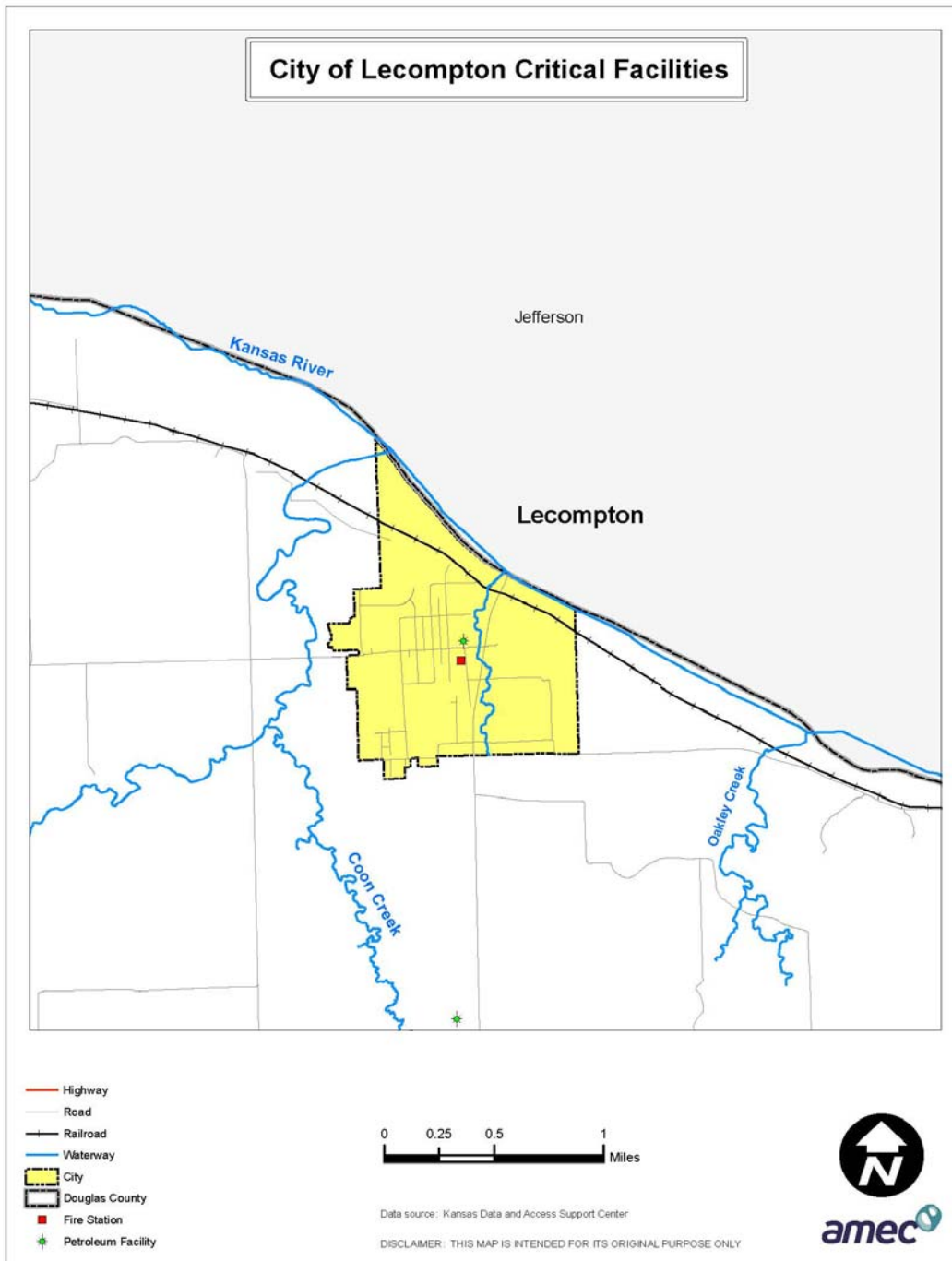


Figure 3.24 City of Lecompton Critical Facilities



Tables 3.21 through 3.25 provide a detailed inventory of specific assets at risk identified by members of the Douglas County Hazard Mitigation Planning Committee. All structural assets and/or occupants are at risk from the following hazards: drought, earthquake, expansive soils, hailstorm, lightning, tornado, utility failure, wildfire, windstorm and winter storm. However, some of the identified hazards are geographically specific and may or may not affect all facilities. These geographic hazards would include: land subsidence, landslide, and flood.

Douglas County - Unincorporated Areas

Table 3.21 Specific Assets at Risk in Unincorporated Douglas County

Name of Asset	Replacement Value	Occupancy/ Capacity #	Hazard Specific Info
RWD #5 Water Towers	\$800,000	400,000 gallons	
RWD #5 Telemetry System	\$100,000		
RWD #5 Pumping Stations (4)	\$450,000		
RWD #5 Other Assets	\$211,000		
RWD #2 Water Tower		250,000 gallons	
RWD #2 Pump Stations (2)			
Clinton Township Fire Equipment	\$350,000		
Lecompton Fire Station #1 & 4 trucks	\$950,000		
Lecompton Fire Station #2 & 2 trucks	\$370,000		
Lecompton Fire Station #3 & 2 trucks	\$370,000		
Tornado Warning Sirens			
Communications Towers			
Mobile Command Vehicle			
RWD #6 Pump Station	\$75,000		
RWD #6 Water Tower	\$500,000		

Baldwin City

Table 3.22 Specific Assets at Risk in Baldwin City

Name of Asset	Replacement Value	Occupancy/ Capacity #	Hazard Specific Info
Baker University Campus – 23 campus buildings	\$25,597,770	379,660 square feet	
USD 348 – Baldwin Schools – 7 buildings	\$25,122,500	Occupancy 2,650	
Police Station / Fire Station	\$ 500,000		
Power Plants Substation	\$11,500,000		
City Hall	\$3,000,000		
Long Term Care Facilities	\$3,000,000		
Water Towers, Pipelines & Pumping Stations	\$ 5,000,000		

Eudora

Table 3.23 Specific Assets at Risk in Eudora

Name of Asset	Replacement Value	Occupancy/ Capacity #	Hazard Specific Info
City Hall	\$473,000		
Eudora Aquatic Center	\$2,970,000		
Public Works Buildings	\$563,976		
Eudora Fire Station	\$1,300,000		
Water Plant	\$2,266,000		
Law Enforcement Center	\$535,128		
Lift Stations x 9	\$1,089,000		
Water Towers x3 and Boost Station	\$1,533,519		
Eudora High School	\$16,885,752		
Eudora Middle School	\$10,354,468		
Main Street Annex	\$6,552,725		
Nottingham Elementary School	\$5,441,674		
West Elementary School	\$5,174,085		
Wastewater Treatment Plant	\$4,723,177		

Lawrence

Table 3.24 Specific Assets at Risk in Lawrence

Name of Asset	Replacement Value	Occupancy/ Capacity #	Hazard Specific Info
University of Kansas – 145 Lawrence campus buildings	\$1,472,661,053	8,642,636 sq feet	Some areas subject to flash flooding
USD 497			
Douglas County Jail	\$25,071,068		
Law Enforcement Center	\$8,770,000		
Other Sheriff Vehicles / Equipment	\$4,734,000		
USD 497 – 55 buildings in 32 locations	\$291,520,786	1,939,342 sq feet 10,680 students	
City Hall			
Municipal Airport			
Carnegie Building			
Community Health Facility			
Fire/Medical Stations x 9			
Community Centers x 3			
Public Works Buildings			
Kaw Water System			
Clinton Water System			
Water Tanks x6			
Waste Water Treatment Plant			
Lift Stations x 41			

Lecompton

Table 3.25 Specific Assets at Risk in Lecompton

Name of Asset	Replacement Value	Occupancy/ Capacity #	Hazard Specific Info
Fire Station			
Outreach Sheriff's Department			
Lecompton Elementary School			
Keystone Learning Center			
City Hall			
Water Treatment Plant & Lagoons			
Community Building			
Constitution Hall			Historic Asset
Lane Museum			Historic Asset
First KS Democratic Headquarters			Historic Asset

Natural, Cultural, and Historic Resources

Assessing the vulnerability of Douglas County to disaster also involves inventorying the natural, historical, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

Natural Resources

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetlands areas protects sensitive habitat as well as attenuates and stores floodwaters.

Wetlands, Exceptional State Waters (ESW), Special Aquatic Life Use Waters (SALU), and Outstanding National Resource Waters (ONWR)

Wetlands are a valuable natural resource for communities, due to their benefits to water quality, wildlife protection, recreation, and education, and play an important role in hazard mitigation. Wetlands provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital and reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. In Douglas County, Appanoose Creek, Buck Creek, the Kansas River, Taury Creek, and the Clinton Reservoir are listed on the Kansas Department of Health & Environment's 8/8/2007 Exceptional State Waters (ESW), Special Aquatic Life Use Waters (SALU), and Outstanding National Resource Waters (ONWR) list as SALUs.

Endangered Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

According to the U.S. Fish and Wildlife Service, as of December 2008 there are two endangered species and two threatened species in Douglas County. These species are listed in Table 3.26.

Table 3.26 Endangered, Threatened, Proposed, and Candidate Species

Common Name	Scientific Name	Status
Mead's Milkweed	<i>Asclepias meadii</i>	Threatened
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered
Topeka Shiner	<i>Notropis topeka</i>	Endangered
Western Prairie Fringed Orchid	<i>Platanthera praeclara</i>	Threatened

Source: United States Department of the Interior Fish and Wildlife Service Ecological Services Kansas Field Office, Endangered, Threatened, Proposed and Candidate Species Kansas Counties, December 2008.

Cultural and Historic Resources

Preservation of the cultural heritage of this area has been identified as an important value and is ensured by a variety of initiatives. Several national and state historic inventories were reviewed to identify historic and cultural assets in Douglas County.

The **National Register of Historic Places** is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior. Table 3.27 lists the seventy-three Douglas County properties that are currently on the National Register of Historic Places or the State of Kansas Register of Historic Places.

Table 3.27 Douglas County properties on the National Register of Historic Places

Property Name	Address	Location	Date Listed
Achning, Ralph and Cloyd House	846 Missouri Street	Lawrence, KS	9/15/1987
Bailey Hall	Jayhawk Boulevard and Sunflower Road	Lawrence, KS	10/22/2001
Barnes Apple Barn	714 E 1728 Road	Baldwin City, Vinland, KS	11/1/2006
Bell, George and Annie, House	1008 Ohio	Lawrence, KS	8/11/1983
Benedict House	923 Tennessee Street	Lawrence, KS	1/22/1992
Black Jack Battlefield	US Hwy 56 & E 200 Road	Baldwin City, KS	4/28/2004
Blood, Col. James, House	1015 Tennessee Street	Lawrence, KS	2/23/1972
Breezdale Historic District	2301-2401 Massachusetts Street	Lawrence, KS	1/31/2008
Case Library, Baker University	Eighth and Grove	Baldwin City, KS	6/5/1986
Chi Omega Sorority House	1345 West Campus Road	Lawrence, KS	1/5/1983
Chicken Creek Bridge	Lone Star vicinity	Lone Star	3/5/1990
Clinton School District 25	1180 N 604 Road	Lawrence, KS	5/1/1998
Coal Creek Library	698 E 1719 Road	Lawrence, KS	12/10/2003
Consolidated Barb Wire Company Building	546 New Hampshire	Lawrence, KS	State Register
Double Hyperbolic Paraboloid House	934 W. 21 st Street	Lawrence, KS	6/27/2007
Douglas County Courthouse	Massachusetts & 11 th streets	Lawrence, KS	4/14/1975
Duncan, Charles, House	933 Tennessee Street	Lawrence, KS	6/5/1986
Dyche Hall	KU Campus	Lawrence, KS	7/14/1974
East Lawrence Industrial District		Lawrence, KS	12/11/2007
Eldridge House Hotel	Seventh and Massachusetts streets	Lawrence, KS	12/1/1986
Eldridge, Shalor, House	945 Rhode Island	Lawrence, KS	8/10/1981
English Lutheran Church	1040 New Hampshire	Lawrence, KS	7/28/1995
Fern and Strong House	1515 University Drive	Lawrence, KS	7/2/2008
Goodrich, Eugene F, House	1711 Massachusetts	Lawrence, KS	10/21/2001
Green Hall	KU Campus	Lawrence, KS	7/15/1974
Greenlee, Michael D, House	947 Louisiana Street	Lawrence, KS	2/20/2004
Hancock (12 th Street) Historic District	12 th Street from Oread to Mississippi	Lawrence, KS	7/21/2004

Property Name	Address	Location	Date Listed
Haskell Institute	23 rd and Barker Avenue	Lawrence, KS	7/4/1961
House Building	729-731 Massachusetts	Lawrence, KS	12/9/2000
House, Edward, House	1646 Massachusetts	Lawrence, KS	4/18/2007
Lane University		Lecompton, KS	3/24/1971
Lawrence's Downtown Historic District	Massachusetts between 6 th Avenue and S. Park Street	Lawrence, KS	7/15/2004
Lecompton Constitution Hall	319 Elmore	Lecompton, KS	5/14/1971
Ludington House	1613 Tennessee	Lawrence, KS	5/14/1971
McCurdy, Witter S, House	909 West 6 th Street	Lawrence, KS	10/21/2001
Miller, Robert H, House	1111 East 19 th Street	Lawrence, KS	6/14/1984
Morse, Dr. Frederic D, House	1041 Tennessee Street	Lawrence, KS	4/18/1991
North Rhode Island St. Historic Residential District	700 -1144, 901-1047, 1201-1215 Rhode Island	Lawrence, KS	7/14/2004
Old Castle Hall	513 Fifth Street	Baldwin City, KS	2/24/1971
Old Lawrence City Library	Ninth and Vermont	Lawrence, KS	2/18/1975
Old West Lawrence Historic District	Bounded by 6 th and 8 th streets	Lawrence, KS	2/23/1972
Oread Historic District	Between W 9 th and 12 th streets	Lawrence, KS	10/10/2007
Parmenter Hall, Baker University	Eighth and Dearborn	Baldwin City	9/19/1977
Pilla, Charles, House	615 Elm	Eudora, KS	1/6/1974
Pinckney Historic District I	Bounded by W 5 th Street, Tennessee Street, W 6 th Street	Lawrence, KS	7/15/2004
Pickney Historic District II	Bounded by W 3 rd Street, Louisiana Street, W 4 th Street, and Mississippi Street	Lawrence, KS	7/15/2004
Plymouth Congregational Church	925 Vermont	Lawrence, KS	8/26/2006
Priestly House	1505 Kentucky Street	Lawrence, KS	3/10/1988
Quayle, William A, House	210 North 6 th Street	Baldwin City, KS	2/2/1995
Riggs, Samuel, House	1501 Pennsylvania	Lawrence, KS	8/29/1977
Robert Hall Pearson Farm	163 E 2000 Road	Baldwin City, KS	8/27/2005
Roberts, John N, House Tea Castle	1307 Massachusetts	Lawrence, KS	9/6/1974
Saint Luke African Methodist Episcopal Church	900 New York Street	Lawrence, KS	8/18/2001
Santa Fe Depot	1601 High	Baldwin City, KS	1/3/1983
Santa Fe Trail – Douglas Co Trail Segments	US 56, 2.5 mile east of Baldwin City	Baldwin City, KS	11/4/2002
Snow House	706 West 12 th Street	Lawrence, KS	9/9/1996
South Rhode Island and New Hampshire Historical District	East and West Rhode Island streets, East and West New Hampshire streets	Lawrence, KS	7/14/2004
Spooner Hall	KU Campus	Lawrence, KS	7/15/1974
Stephens, Judge Nelson T, House	340 North Michigan Street	Lawrence, KS	2/19/1982
Stoebener Barn	Baldwin vicinity	Baldwin City, KS	1/9/1989

Property Name	Address	Location	Date Listed
Stony Point Evangelical Lutheran Church	1575 N 600 Road	Baldwin City, KS	12/20/2006
Strong Hall	213 Strong Hall University of Kansas	Lawrence, KS	9/18/1998
Taylor, Lucy Hobbs, Building	809 Vermont	Lawrence, KS	2/19/1982
U.S. Post Office	645 New Hampshire	Lawrence, KS	10/31/2002
Union Pacific Depot	North Second Street	Lawrence, KS	8/22/1992
Usher, John Palmer, House	1425 Tennessee	Lawrence, KS	3/7/1975
Vermilya-Boener House	Grant Township	Rural Douglas County	1/24/1992
Vinland Fair Association Fairgrounds Exhibit Building	1736 N 700 Road	Vinland, Baldwin City, KS	1/23/2004
Vinland Grange Hall	Junction of Oak and Main Streets	Vinland, KS	2/10/2000
Vinland Presbyterian Church	697 E 1725 Road	Vinland, Baldwin City, KS	8/4/2003
Watkins National Bank (Old Lawrence City Hall)	1047 Massachusetts	Lawrence, KS	2/24/1971
Wiggins, Dudley, House	840 West 21 st Street	Lawrence, KS	5/10/1986
Zimmerman, S.T., House	304 Indiana	Lawrence, KS	9/6/1974

http://www.kshs.org/resource/national_register/index.php

It should be noted that as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Economic Assets

Economic assets at risk may include major employers or primary economic sectors, such as agriculture, whose losses or inoperability would have severe impacts on the community and its ability to recover from disaster. After a disaster, economic vitality is the engine that drives recovery. Every community has a specific set of economic drivers, which are important to understand when planning ahead to reduce disaster impacts to the economy. When major employers are unable to return to normal operations, impacts ripple throughout the community. Table 3.28 lists the top 10 employers in Douglas County.

Table 3.28 Top 10 Employers in Planning Areas

Employers	Product/Service	Full & Part-Time Employees
University of Kansas	Education	9,396
Pearson Government Solutions	Information Services	1,800
Lawrence Public Schools	Education	1,710
City of Lawrence	Government	1,250
Lawrence Memorial Hospital	Health Care	1,200
Hallmark Cards, Inc	Manufacturing	814
The World Company	Media	600
Baker University	Education	593
Amarr Garage Doors	Manufacturing	588
K-Mart Distribution	Retail Distribution	452

Social Vulnerability

Certain demographic and housing characteristics may amplify or reduce overall vulnerability to hazards. These characteristics, such as age, race/ethnicity, income levels, gender, building quality, and public infrastructure, all contribute to 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. Compared to other counties in the nation and in Kansas, Douglas County's social vulnerability rating is low.

Future Land Use and Development

As demonstrated in Table 3.29, all areas of Douglas County are growing. Eudora is growing the fastest, doubling its population from 1990 to 2006. Housing units are also on the rise increasing in all areas of the county from 1990 to 2000. Lecompton has seen the least growth, with a population increase of 4 percent and housing unit increase of 5 percent.

Table 3.29 Changes in Population and Housing Units, 1990-2006

Location	1990 Population	2000 Population	2006 Population Estimate	Estimated Percent Change 1990-2006	1990 # of Housing Units	2000 # of Housing Units	Estimated Percent Change 1990-2000
Douglas County	81,798	99,962	112,123	37%	31,782	40,250	27%
Lawrence	65,608	80,098	88,605	35%	25,893	32,761	27%
Eudora	3,006	4,307	6,027	100%	1,136	1,664	46%
Lecompton	619	649	649	4%	221	233	5%
Baldwin City	2,961	3,400	4,145	40%	961	1,165	21%

3.3.3 Vulnerability by Hazard

In order to focus on the most critical hazards, those assigned a level of high or moderate planning significance 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.

This section describes overall vulnerability, identifies structures, and estimates potential losses to buildings, infrastructure, and critical facilities located in identified hazard areas. This assessment was limited to the hazards that were considered moderate or high in planning significance, based on HMPC input and the hazard profiles. Hazards ranked of low significance due to a lack of notable past damage or very low probabilities are not included in the detailed vulnerability assessment. The vulnerability overview for these hazards concludes that the planning area is minimally vulnerable to damages as a result of these hazards. The hazards with a low planning significance include the following:

- Earthquake
- Land Subsidence
- Landslide
- Soil Erosion/Dust

This assessment is also limited by the data available for the high or moderate ranked hazards. The methods of analysis vary by hazard type and available data. Many of the identified hazards, particularly weather related hazards, affect the entire planning area, and specific hazards areas cannot be mapped geographically. For these hazards vulnerability is mainly discussed in qualitative terms because data on potential losses to structures is not available.

Agricultural Infestation

Vulnerability Overview

According to the 2006 Kansas Farm Facts, there are approximately 880 farms in Douglas County encompassing 202,000 acres. In 2006, 105,300 of those acres were harvested for a total value of crops harvested at \$20,607,900. All of those lands used for agricultural purposes would be vulnerable to this hazard. In Douglas County, a significant percentage of farms are maintained as organic. There are also several vineyards in Douglas County. The Kansas Department of

Agriculture maintains a registry of sensitive crops. Table 3.30 lists the 31 sensitive crops registered in Douglas County as of 10/2/2008.

Table 3.30 Sensitive Crops Registered in Douglas County 10/2/2008

Business Name	Zip Code	City	Sensitive Crop
John Thomas	66006	Baldwin City	Grapes
Rick & Debby Hird	66006	Baldwin City	Grapes
Lawson Brothers Farm	66006	Baldwin City	Small Fruit
Vinland Valley Nursery	66006	Baldwin City	Nursery, Greenhouse
Blossom Trail Bee Ranch	66006	Baldwin City	Fruit Trees, Vegetables, Honey Bees
Buckets of Berries	66006	Baldwin City	Strawberries, Blueberries
Spring Creek Farm		Baldwin City	Organic Crops, Berries
Prairie Creek Vinyard	66021	Edgerton	Wine Grapes
Enright Gardens	66021	Edgerton	Greenhouse
Davenport Orchard & Vineyards	66025	Eudora	Grapes, Melons, Tomatoes, Eggplant
Selvan Vinyard	66025	Eudora	Grapes
Captain Creek Produce	66025	Eudora	Tomatoes, Vegetables
Blue Jacket Vinyard, Crossing Winery	66025	Eudora	Grapes
Lorri Sudlow	66047	Lawrence	Grapes, Fruit Trees
Charles Novogradac	66044	Lawrence	Nut Trees
Pinwheel Farm	66044	Lawrence	Organic Crops
Bob Marshall	66046	Lawrence	Organic Crops
Charles Hagen	66044	Lawrence	Tomatoes
Wild Onion Farm	66047	Lawrence	Cut Flowers, Tomatoes
Mark Lumpe	66047	Lawrence	Grapes
Moon Over the Meadow	66046	Lawrence	Organic Crops
Kuglers Vinyard	66047	Lawrence	Grapes
Harmony Acres	66046	Lawrence	Grapes
Vertacnik Orchard	66046	Lawrence	Apples
Pendleton's Country Market	66046	Lawrence	Tomatoes, Greenhouse Flowers
Schaake Farms	66046	Lawrence	Pumpkins
The Iris Place	66046	Lawrence	Iris Plants, Peony Plants, Tomatoes
MWB Produce	66047	Lawrence	Vegetables, Fruits, Tomatoes
Chestnut Charlie's Organic Tree Crops	66044	Lawrence	Certified Organic Chestnuts, Pecans and Walnuts
William Fair	66050	Lecompton	Fruit Trees
Voights Greenhouse	66092	Wellsville	Tomatoes, Greenhouse

Kansas Department of Agriculture, Registry of Sensitive Crops 10/1/2008

Identifying Structures and Estimating Potential Losses

Buildings, infrastructure, and critical facilities are not vulnerable to this hazard. It affects only crop or livestock based products of agriculture. The impacts and potential losses are largely economic and are dependent on the type, extent, and duration of the infestation. One way to estimate vulnerability would be to inventory the value of crops exposed to the hazard. For example, according to the Kansas Agricultural Statistics 2006 Farm Facts Report, the value of the crops harvested in Douglas County in 2006 was \$ 20,607,900. While it is difficult to estimate how much crop would be destroyed in an event, a 10 percent loss of the 2006 crop

would have been \$ 2,060,700. The value of cattle and milk products in the county during the same period is estimated at \$ 9,524,700. A 10 percent loss of this asset would be \$ 952,470.

Future Development

Growth in the agricultural industry is limited at this time, although an increase in the number of farms, especially organic farms and vineyards, could significantly increase the losses experienced from an agricultural infestation.

Dam and Levee Failure

Vulnerability Overview

Dam or levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake. Data from the National Inventory of Dams and State of Kansas indicates that Douglas County has six high hazard dams and a levee on the Kansas River in the City of Lawrence.

Identifying Structures and Estimating Potential Losses

If Clinton Lake Dam or the Wakarusa Reservoir Dam (FRD No 24) in the City of Lawrence were to fail the potential losses would be in the millions of dollars. The Clinton Lake Inundation Map and Aerial Photography and five other high hazard dams are included in Figures 3.25 3.30.

Figure 3.25 Clinton Lake Dam Inundation Map

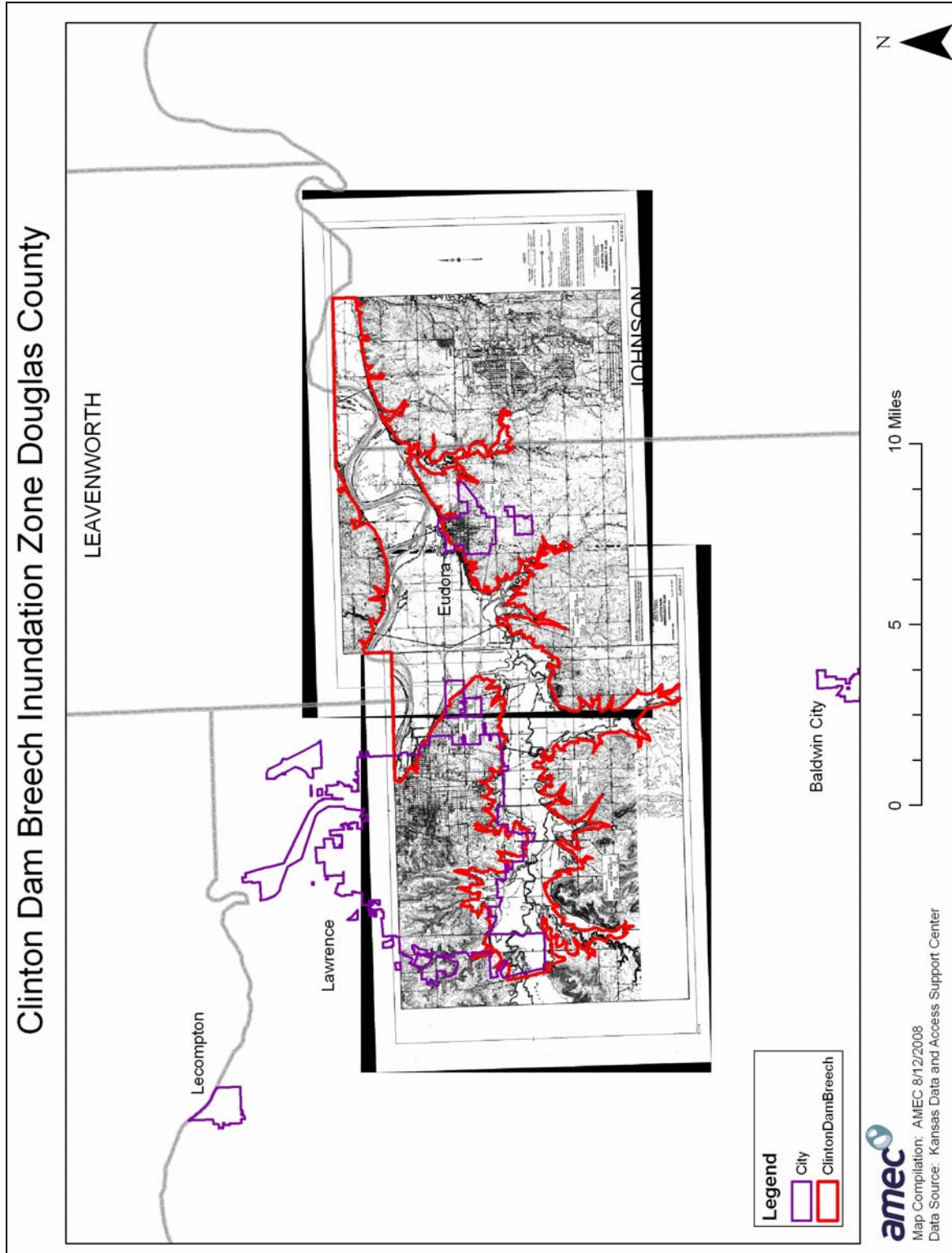


Figure 3.26 Wakarusa Reservoir Dam in the City of Lawrence



Figure 3.27 Lonestar Lake Dam Douglas County Washington Creek

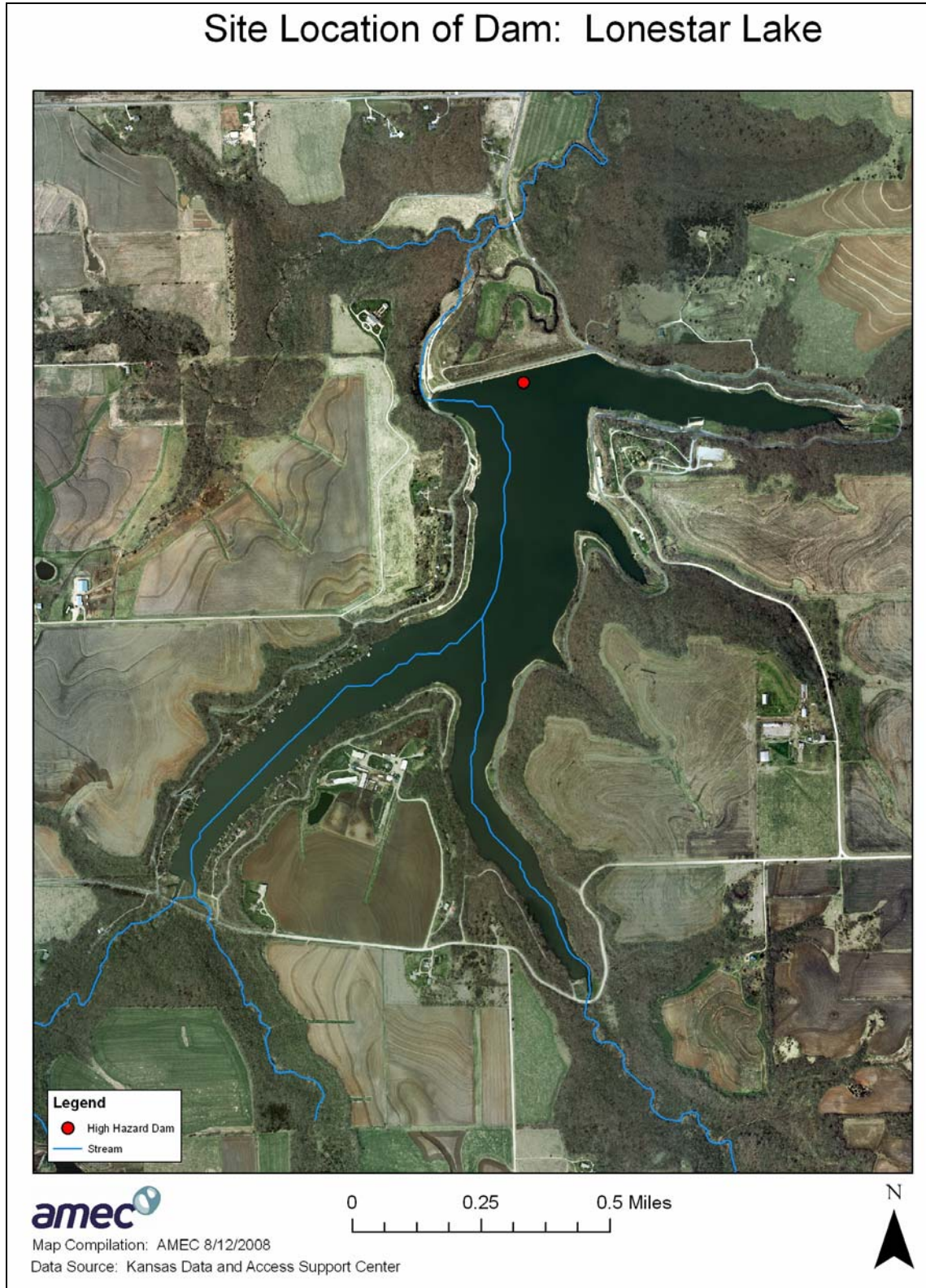


Figure 3.28 Douglas County, Wakarusa Tributary

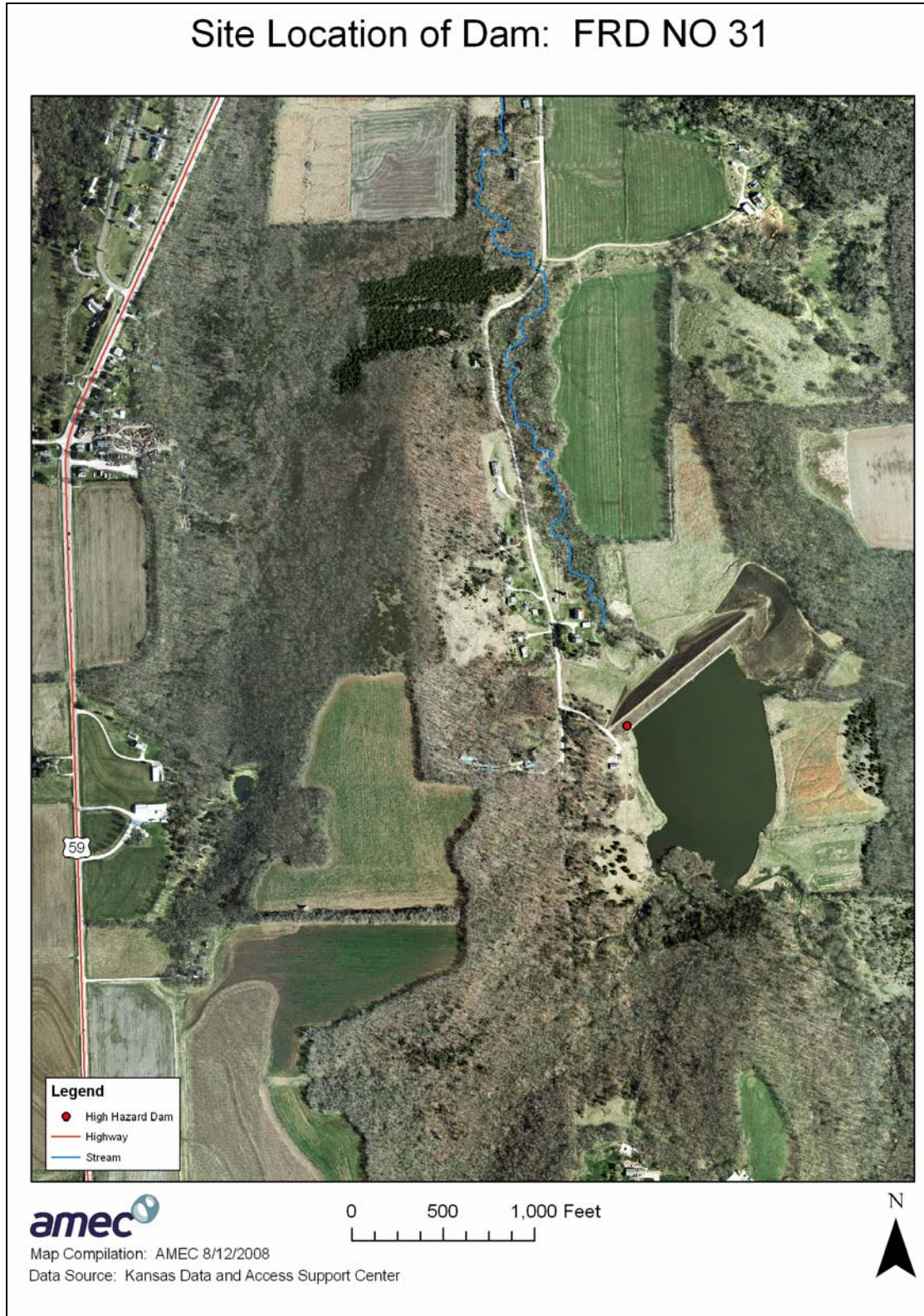
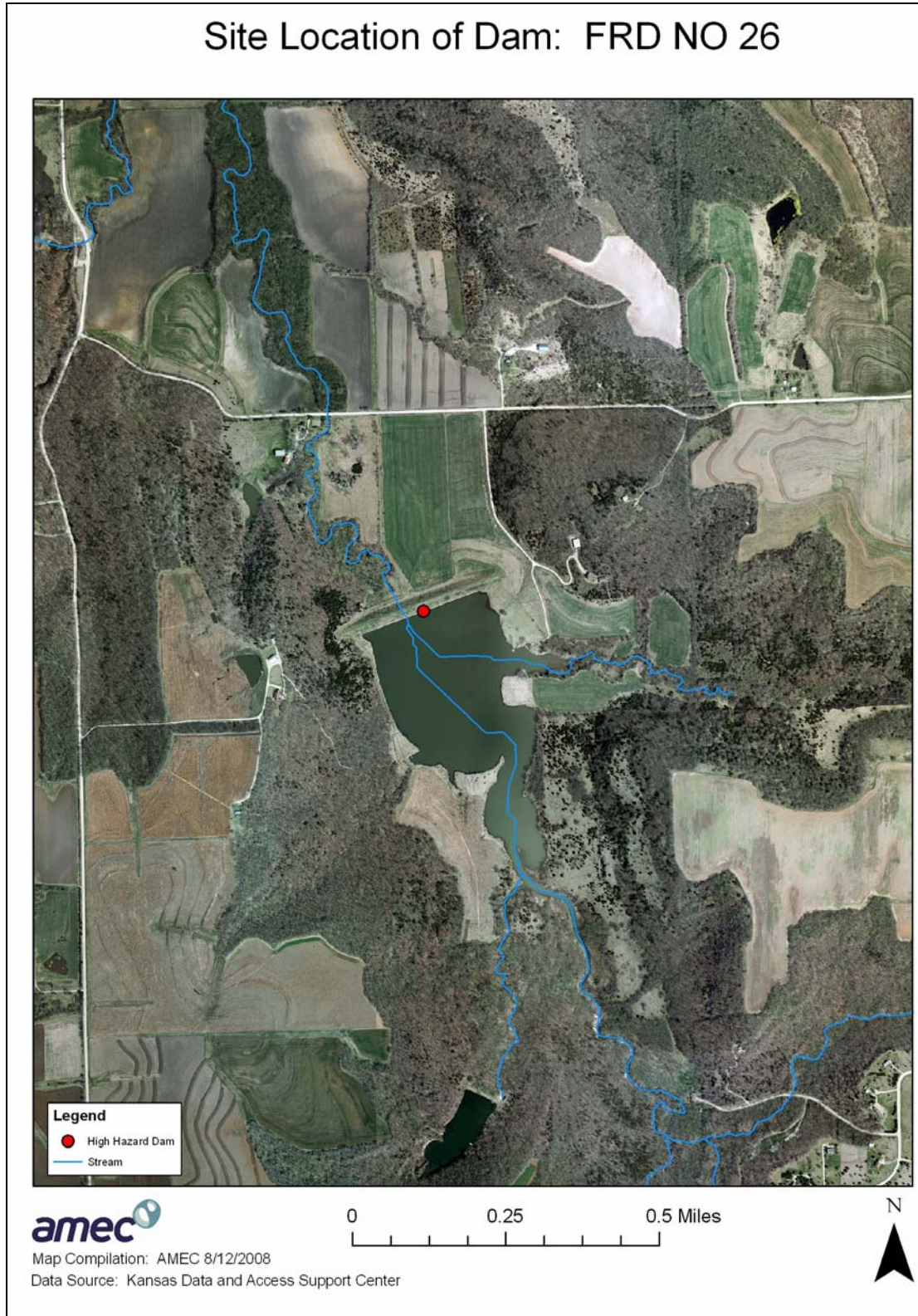


Figure 3.29 Douglas County, West Branch Taury Creek Tributary



Figure 3.30 Douglas County, Chicken Creek Tributary



Future Development

Future development located downstream from dams in floodplains or inundation zones would increase Douglas County's vulnerability to this hazard.

Drought

Vulnerability Overview

A significant percentage of the acres in Douglas County are used for agricultural purposes, such as vineyards or fields planted with crops. The agricultural economy of Douglas County is vulnerable to periods of drought. Drought can also affect the water supply and water quality in the County. Drought increases the impacts of soil erosion and dust and the risk of wildfire hazards. Based on a report by the Kansas Water Office in 2007 no Douglas County public water suppliers are specifically listed in the report as drought vulnerable.

Identifying Structures and Estimating Potential Losses

Drought normally does not impact structures and it can be difficult to identify specific hazard areas other than agricultural areas. The impacts and potential losses are largely economic and are dependent on the type, extent, and duration of the drought. One way to estimate vulnerability would be to inventory the value of crops damaged by the drought. According to the Kansas Agricultural Statistics 2006 Farm Facts Report, the value of the crops harvested in Douglas County in 2006 was \$ 20,607,900. While it is difficult to estimate how much crop would be destroyed during a drought because of varying durations, using the HMPC's estimate of a 10-25% loss, loss estimates for the 2006 crop would have been \$ 2,060,700 to \$5,151,750.

Future Development

Generally as population grows, demand for water increases for household, commercial, industrial, recreational, and agricultural uses. In recent decades population has significantly increased in Douglas County. The numbers of organically based small agricultural farms has also increased in the last decade. Based on these assessments future development is likely to exacerbate drought related losses in the short term.

Expansive Soils

Vulnerability Overview

The entire area is vulnerable to expansive soils. Issues with expansive soils usually result during periods of drought, so the vulnerability is related to that hazard as well.

Identifying Structures and Estimating Potential Losses

The structures most vulnerable include basement walls, sidewalks and roadways. Damages associated with residential structures are usually minor and are covered by homeowner's insurance, however damages to roadways can be substantial and repairs costly. Data regarding road repairs is not currently available by damage cause.

Future Development

An increase in the population in the area and in residential structures which have basements will increase vulnerability.

Extreme Temperatures

Vulnerability Overview

The elderly population in the planning area is most vulnerable to extreme temperatures. The 2006 population estimates by American Factfinder indicate that the percentage of elderly people in the planning area is 8.7 percent. In addition, the percentage of individuals below the poverty level is 19.8 percent, well above the national average of 13.3 percent. These individuals may be at increased risk to extreme heat if air conditioning or heating is not affordable. The HMPC identified the power distribution and infrastructure as vulnerable to outages during periods of extreme heat when the use of air conditioning puts a strain on power generation and transmission. The power distribution and infrastructure is also vulnerable during extreme cold events that involve winter storms, specifically ice storms.

Identifying Structures and Estimating Potential Losses

Extreme heat and/or cold normally do not impact structures and it is difficult to identify specific hazard areas. Data is not available to estimate potential losses to structures in identified hazard areas. Nursing homes and elder care facilities are especially vulnerable to extreme heat events. The power infrastructure is known to be at risk, but at this time, there is no data available to estimate potential dollar losses as a result of power failure during extreme heat events. The Kansas Department of Aging reports that there are 728 long term care beds in Douglas County. Individuals residing in these facilities are classified as extremely susceptible to loss of air conditioning/heating. Individuals classified as homeless are also at risk.

Future Development

A growing population increases the number of people vulnerable to extreme heat events; new development increases the strain on the power grid during extreme heat and extreme cold periods. The coordination of efforts to end chronic homelessness in the Lawrence area includes the implementation of the Homeless Management Information System (HMIS). The Lawrence Chamber of Commerce implemented HMIS with nine participating agencies in 2006 and will transition to the statewide HMIS during 2008. The HMIS will include HUD funded and non-HUD funded emergency shelters, transitional housing and permanent supportive housing programs, as well as service agencies providing outreach and case management services to homeless. These changes are designed to decrease the numbers of chronically homeless according to the August 1, 2008 to July 31, 2009 City of Lawrence Consolidated Plan and annual action plan.

Flood

Vulnerability Overview

According to the vulnerability analysis and the loss estimates provided in this section, the City of Lawrence would be hit the hardest by a 100-year flood followed distantly by the unincorporated areas of the county.

Identifying Structures and Estimating Potential Losses

The best available data for flooding in Douglas County was generated by HAZUS-MH MR3, FEMA's software program for estimating potential losses from disasters.

HAZUS was used to generate a one percent annual flood, or base flood, event for major rivers and creeks in the County. The software produces a flood polygon and flood-depth grid that represents the base flood. While not as accurate as official flood maps, such as digital flood insurance rate maps, these floodplain boundaries are used in GIS-based loss estimation.

HAZUS provides reports on the number of buildings impacted, building repair costs, and the associated loss of building contents and business inventory. Building damage can cause additional losses to a community as a whole by restricting the building's ability to function properly. Income loss data accounts for business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses. These losses are calculated by HAZUS using a methodology based on the building damage estimates. Flood damage is directly related to the depth of flooding. For example, a two-foot flood generally results in about 20 percent damage to the structure (which translates to 20 percent of the structure's replacement value).

After running the HAZUS analysis for the 100-year flood event, the building inventory loss estimates (which are linked to census block geography) were sorted by incorporated communities in Douglas County and the unincorporated County to illustrate how the potential for loss varies across the planning area. Table 3.31 shows estimated potential building losses by jurisdiction.

Unincorporated areas of the County and the City of Lawrence are at most risk to flood losses according to this analysis. The unincorporated County accounts for about 21 percent of loss, the City of Lawrence for about 77.5 percent, and the City of Eudora for about 1.4 percent. In Baldwin City and Lecompton there is little risk to property.

Table 3.31 Estimated Flood Losses by Jurisdiction

City	Building Damage ()	Inventory Loss ()	Relocation Loss ()	Lost Wages ()	Rental Income Loss ()	Total Loss ()	Percent of Total
Baldwin	0	0	0	0	0	0	0
Eudora	3,024,920	241,994	6,049	24,199	3,024	3,300,186	1.4
Lawrence	162,485,290	12,998,823	324,970	1,299,882	162,485	177,271,450	77.5
Lecompton	57,870	4,629	115	462	57	63,133	.03
Unincorp. Douglas Co.	44,017,040	3,521,363	88,034	352,136	44,017	48,022,590	21
Totals	209,585,120	16,766,809	419,168	1,676,679	209,583	228,657,359	100

Source: HAZUS-MH MR3

Default HAZUS-MH data was used to develop the loss estimates. Thus, the potential losses derived from HAZUS-MH, the best available data, may contain some inaccuracies. The building valuations used in HAZUS-MH MR3 are updated to R.S. Means 2006 and commercial data is updated to Dun & Bradstreet 2006. There could be errors and inadequacies associated with the hydrologic and hydraulic modeling of the HAZUS-MH model. The damaged building counts generated by HAZUS-MH are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis.

Figures 3.31 through 3.33 show the flood plain maps for each potentially affected jurisdiction.

Figure 3.31 City of Eudora HAZUS Floodplain

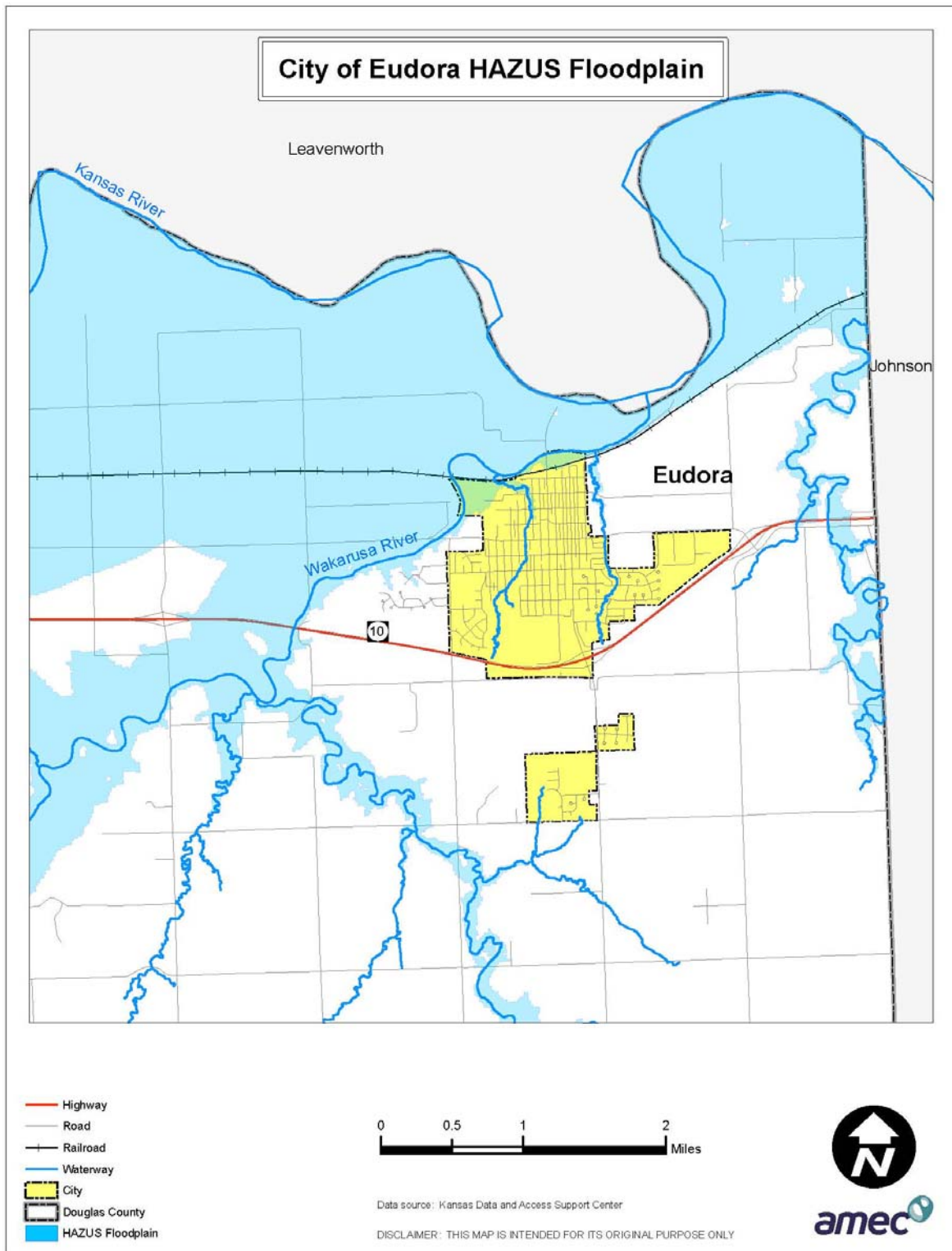


Figure 3.32 City of Lawrence HAZUS Floodplain

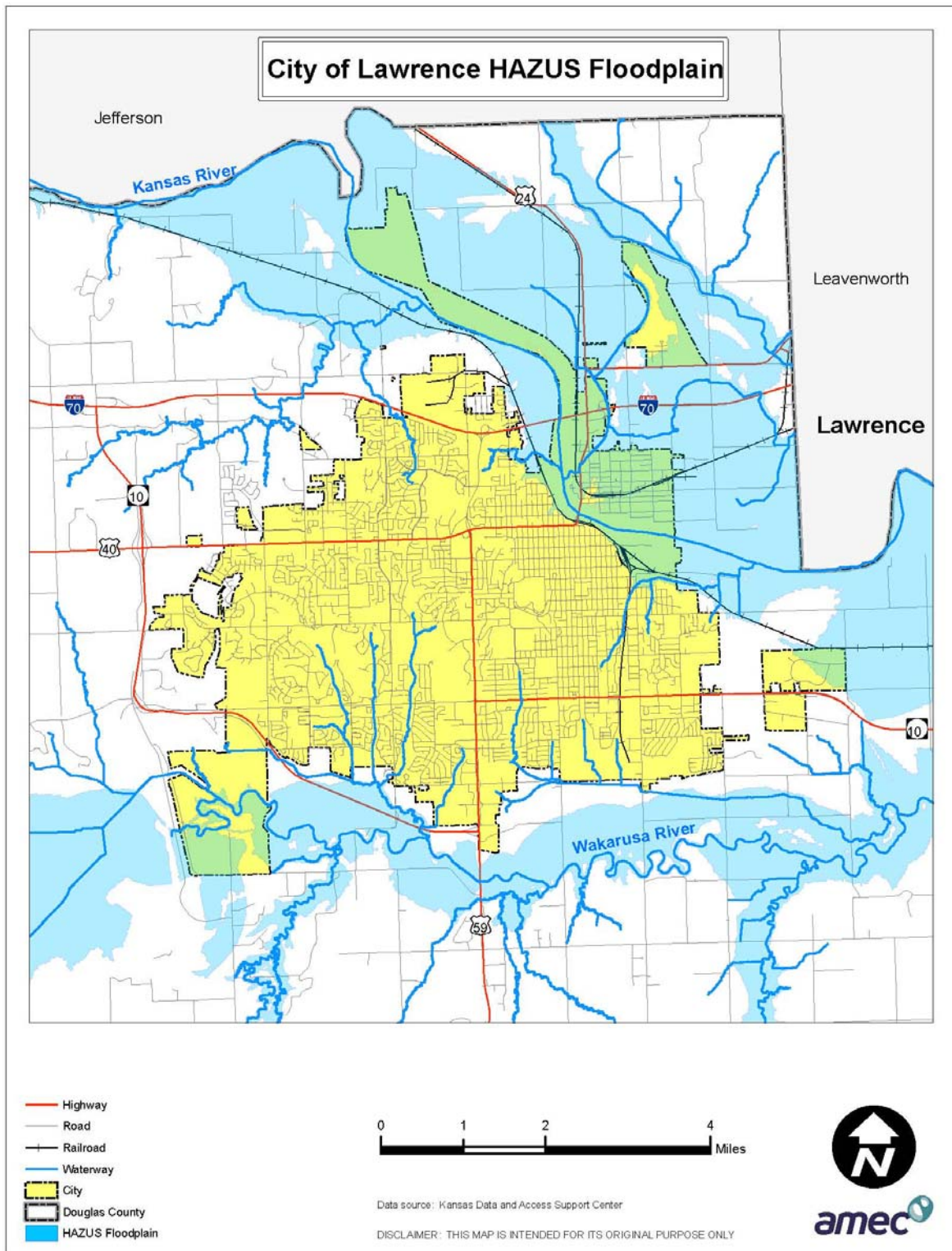


Figure 3.33 City of Lecompton HAZUS Floodplain



National Flood Insurance Program and Repetitive Loss Properties

Table 3.32 provides detailed information on National Flood Insurance Program (NFIP) policies in NFIP participating jurisdictions in Douglas County.

Table 3.32 National Flood Insurance Participating Jurisdictions, Douglas County, Kansas

Jurisdiction	Date Joined	Effective FIRM date	Policies in Force	Insurance in Force ()	Number of Claims	Claims Total ()
Douglas County	3/2/1981	3/2/1981	92	\$15,247,800	12	\$130,057
Baldwin City	1/2/1980	1/2/1980	17	\$2,767,100	0	\$0
Eudora	1/16/1981	1/16/1981	19	\$2,024,300	5	\$77,589
Lawrence	3/2/1981	3/2/1981	494	\$77,006,600	60	\$507,317
Lecompton	3/15/1979	3/15/1979	0	\$0	0	\$0

There are 5 repetitive loss properties in Douglas County, 3 in Lawrence, 1 in Eudora and 1 in the unincorporated County.

Douglas County - Of the 92 policies in force in the unincorporated County, 79 are residential and 13 are non-residential. Fifty-nine (59) of the policies are in special flood hazard area A and or AE and 33 are in B, C, and X Zones. There have been 12 historical claims for flood losses; 8 claims totaling \$80,177.36 were in Zone A or AE and the remaining 4 totaling \$49,879.87 were in Zones B, C, and X.

Baldwin City There are 17 policies in force in Baldwin City and all are residential policies. Ten (10) of the insured properties are in flood hazard area A or AE and the remaining 7 are in Zones B, C or X. There have not been any claims for losses.

Eudora Of the 19 policies in force in Eudora, all are residential. Of those, 15 are in special flood hazard areas A or AE and the remaining 4 are in flood hazard areas B, C and X. A total of 5 claims totaling \$76,689.37 have been for properties in the special flood hazard areas A and AE.

Lawrence Of the 494 policies in force in Lawrence, 453 are residential and 41 are non-residential. Of the policies, 347 are in special flood hazard areas A, AE or AH and the remaining 147 are in flood hazard areas B, C and X. A total of 33 claims totaling \$304,501.41 have been for properties in the special flood hazard areas A and AE and 26 claims totaling \$199,588.38 have been for properties in Zones B, C or X.

Lecompton Although the community is listed as a participating community in the National Flood Insurance Program, there are currently no policies in force. Two (2) historical claims totaling \$18,426.64 were paid for losses in flood hazard areas A or AE.

Future Development

The risk of flooding to future development in Douglas County should be minimized by the floodplain management programs of the County and jurisdictions in the planning area, if

properly enforced. Risk could be further reduced by strengthening floodplain ordinances beyond minimum NFIP requirements.

Fog

Vulnerability Overview

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. The entire planning area is affected by the hazard.

Identifying Structures and Estimating Potential Losses

The Kansas Department of Transportation Accident Statistics for 2007 indicate that 0.14% of all traffic accidents were related to fog. Although no specific data is available by cause at the county level, assuming that the geography of Douglas County isn't significantly more or less susceptible to fog than other areas, an extrapolation of the number of accidents can be made. In 2007, there were 3,518 traffic accidents in Douglas County. Assuming 0.14% of them were related to fog, smoke or smog, that would be 49 accidents.

Future Development

Future development in the Douglas County planning area is not expected to significantly increase or decrease the likelihood of fog related incidents.

Hail Storm

Vulnerability Overview

All of Douglas County is vulnerable to hail storms. In general, assets in the planning area that are vulnerable to hail damage include crops, livestock, vehicles, people, and built structures. Of these, crop damage is the most common. Moderate to large size hail can devastate crops that are at vulnerable stages in the growth/harvest cycle. Injuries to humans and livestock can occur if shelter is not available during a severe hail event.

Identifying Structures and Estimating Potential Losses

Vehicle damage is a common impact, ranging from minor cosmetic impacts to moderate body damage. For structures roof damage, damages to siding and windows occurs frequently with hail damage and is usually covered under private insurance. Specific predictive data regarding cost of hail damage in Douglas County is not available.

Future Development

The impact of the hazard on any future development would be related to the type of structure/asset that was involved. As populations increase so do the assets likely to be damaged by hail, specifically home roofs and vehicles.

Land Subsidence

Vulnerability Overview

According to the Kansas Geological Survey, there have been several documented sinkholes in Douglas County. However, the HMPC did not have additional information regarding the locations or vulnerable assets.

Identifying Structures and Estimating Potential Losses

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. There is not enough information within this report to support estimates of future losses from subsidence. 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.

Future Development

Additional research is needed to determine if there are areas that are more prone to land subsidence within the planning area. If vulnerable areas are determined, future development should not occur in these locations.

Lightning

Vulnerability Overview

All of the planning area is vulnerable to lightning. National Weather Service data indicates that Douglas County is in a region that receives four to eight lightning strikes per square kilometer per year. However, most of these lightning strikes do not result in damages and those that are damaging are usually covered by insurance. The NCDC reports 3 injuries in Douglas County resulting from lightning strikes from 1993-2007. The HMPC considered lightning to be a significant public safety hazard. Most damages occur to electronic equipment located inside buildings. Communications equipment and warning transmitters and receivers could be knocked out by lightning strikes.

Identifying Structures and Estimating Potential Losses

Specific dollar losses are not available for the widespread impacts that can occur to personal electronics equipment.

Future Development

Current development trends for Douglas County are unlikely to substantively increase or decrease vulnerability to lightning.

Tornado

Vulnerability Overview

The potential for a tornado that causes widespread damage in Douglas County is likely based on historical events. All above-ground buildings, infrastructure, and critical facilities are at risk of damage. Only a limited number of buildings have FEMA approved tornado shelters.

Identifying Structures and Estimating Potential Losses

To assess vulnerability to this damaging hazard, the HMPC considered the impacts of the recent tornado in Greensburg, Kansas (2007). On May 4, 2007, Greensburg was hit by an EF5 tornado. The tornado was estimated to be 1.7 miles in width and traveled for nearly 22 miles. Ninety-five percent of the city was confirmed to be destroyed, with the other 5 percent severely damaged. Greensburg has a population of approximately 1,500 with 1.5 square miles in city limits. Lawrence, the largest city within the planning area has a 2006 population estimate of 88,605 with 28.7 square miles in city limits.

If a tornado event similar to that of Greensburg occurred in the populated sections of the planning area, it is conceivable that a similar level of destruction could occur. The estimates of potential losses for an EF5 event by calculating a 95 percent loss of structure value in Lawrence as the worst case scenario are as follows. It should be noted that this methodology is inexact as the assets of the community are assumed to be spread evenly over the 28.7 square mile city area. Table 3.33 summarizes the analysis.

Table 3.33 Property Damage Estimates for a 1.5 Mile Wide EF5 Tornado in Lawrence

Area	# of Structures	Structure Value	Contents Value	Total Value
Lawrence	26,976	\$5,329,707,000	\$3,551,443,000	\$8,881,150,000
1.5 square mile value	12,139	\$2,398,368,150	\$1,598,149,350	\$3,996,517,500
95% within affected area	11,532	\$2,278,449,743	\$1,158,241,883	\$3,436,691,626

Future Development

Future residential or commercial buildings built to code should be less vulnerable to tornadoes. The number of schools and communities within the jurisdiction wishing to include a FEMA shelter is increasing, and although these shelters will not decrease the amount of property damaged, they will save lives. Future development that does occur in Douglas County should consider tornado hazards at the planning, engineering and architectural design stages.

Utility Infrastructure Failure

Vulnerability Overview

In Douglas County, electric utilities and infrastructure are the most vulnerable to damage by natural hazards. Typically the events that cause the most damages are winter storm and wind storm. In most areas of Douglas County, the electric utilities are above ground. It is not unusual for power outages to last for a week in some areas.

Identifying Structures and Estimating Potential Losses

Because most electric utilities are above ground, power lines and power poles are the structures most likely to be affected and cause a utility infrastructure failure. Although no specific methodology exists for estimating potential losses from utility infrastructure failure, economic losses could be expected if electric power cannot be provided to local industrial operations. The local rural electric cooperative, Kaw Valley REC reports that in their 6 county service area they have 8,000 services, and 1,546 miles of lines. Potential losses would include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses. Secondary effects of infrastructure failure could include burst water pipes in homes without electricity during winter storms and damage to equipment due to power surges in the electrical grid during blackouts. Public safety hazards include risk of electrocution from downed power lines and hazard events that affect the normal functioning of wastewater facilities.

Future Development

The development and increase in residential population in Douglas County will increase the need for utility infrastructure. The HMPC recognizes the need for investment in the electrical utility infrastructure, including burial of electric utilities and the addition of poles in areas prone to ice accumulation. These actions should decrease future losses.

Wildfire

Vulnerability Overview

Based on wildfire information from Kansas Incident Fire Reporting System (KIFRS), this hazard is a public safety issue. One civilian injury occurred in 2006 in Douglas County. According to the HMPC, the areas that are most vulnerable to wildfire are agricultural areas where CRP land is burned, rural areas where trash and debris are burned, and the wildland-urban interface areas.

Table 3.34 summarizes the results of the Kansas Forest Service Community Wildfire Assessment that was completed for Douglas County in June of 2008. This report is provided in its entirety in Appendix D.

Table 3.34 Community Wildfire Assessment Findings

Low Risk Areas	Moderate Risk Areas	High Risk Areas
Eudora	Stull	Clinton Lake
Lawrence		Wakarusa
Lecompton		Kanwaka

Identifying Structures and Estimating Potential Losses

Homes built in rural areas are more vulnerable since they are in closer proximity to CRP land that is burned and homeowners are more likely to burn trash and debris in rural locations. The vulnerability of structures in rural areas is exacerbated due to the lack of hydrants in these areas for firefighting and the distance required for firefighting vehicles and personnel to travel to respond. Potential losses to crops and rangeland are additional concerns. Based on Kansas Fire Incident Reporting System data, property damage totaled \$779,630 for 2006.

Future Development

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 structures and people are at risk.

Windstorm

Vulnerability Overview

Windstorms in Douglas County are rarely life threatening, but do disrupt daily activities and cause damage to buildings, trees, and utilities.

Identifying Structures and Estimating Potential Losses

Windstorms affect the entire planning area, including all above-ground structures and utilities. There are no specifically identified hazard areas or available data to identify specific structures at risk or estimate potential losses.

Future Development

Future development projects should consider windstorm hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability.

Winter Storm

Vulnerability Overview

Overall vulnerability to winter storms relative to other hazards is considered high, with significant potential impact to the general population and/or built environment and significant exposure of assets. Winter storms typically involve snow and ice, occasionally accompanied by high winds, which can cause downed trees and power lines, power outages, accidents, and road

closures. Transportation networks, communications, and utilities infrastructure are the most vulnerable physical assets in the planning area. The most significant damage during winter storm events occurs when freezing rain and drizzle accumulate on utility poles and power lines causing widespread power outages.

During heavy snow and ice events, the threat to public safety is typically the greatest concern. Lower income and elderly populations are more at risk in cases of power outages during winter storms. These storms also impact the local economy by disrupting transportation, school and commercial activities. Travelers on roadways and highways in Douglas County, particularly along remote stretches of road, can become stranded, requiring search and rescue assistance and shelter provisions. Agriculture and livestock are also vulnerable to extreme cold temperatures and heavy snow.

Identifying Structures and Estimating Potential Losses

Buildings that have tree limbs hanging over them are more vulnerable to damage by falling tree limbs. Utility power poles and lines are the critical facilities that are most vulnerable. Potential losses to the electric line infrastructure are difficult to quantify. Roads and bridges covered with ice make travel treacherous and slow emergency vehicles. Businesses experience losses as a result of closure during power outages. Schools also often must close. Other losses as a result of winter storm are not quantifiable at this time.

Future Development

Residential development is occurring in most incorporated cities within Douglas County, with the most rapid growth in Lawrence. Although future residential or commercial buildings built to code should be able to withstand snow and ice loads from severe winter storms, the increased number of developments will place additional demands for utility infrastructure on the current systems. The HMPC recognizes the need for investment in the electrical utility infrastructure, including burial of electric utilities and the addition of poles in areas prone to ice accumulation. These actions should decrease future losses.

3.3.4 Summary of Key Issues

Table 3.35 shows the results of the Hazard Ranking in order of High to Low Planning Significance based on the methodology described in section 3.1.

Table 3.35 Douglas County Hazard Ranking-High to Low Planning Significance

Hazard Type	Probability	Magnitude	Warning Time	Duration	CPRI	Planning Significance
Utility / Infrastructure Failure	4	3	4	4	3.70	High
Flood	4	3	3	4	3.55	High
Windstorm	4	3	4	2	3.50	High
Winter Storm	4	3	2	4	3.40	High
Extreme Temperatures	4	3	1	4	3.25	High
Tornado	3	4	4	1	3.25	High
Hailstorm	4	2	4	1	3.10	High
Wildfire	3	2	4	3	2.85	Moderate
Fog	4	2	2	1	2.80	Moderate
Lightning	4	2	2	1	2.80	Moderate
Drought	3	2	1	4	2.50	Moderate
Expansive Soils	3	2	1	4	2.50	Moderate
Dam and Levee Failure	1	4	2	4	2.35	Moderate
Agricultural Infestation	2	2	1	4	2.05	Moderate
Earthquake	1	2	4	1	1.75	Low
Land Subsidence	1	1	4	4	1.75	Low
Soil Erosion & Dust	1	2	1	4	1.60	Low
Landslide	1	1	3	1	1.30	Low

The HMPC will focus efforts for the mitigation strategy on those hazards with a moderate and high planning significance. The following section summarizes key issues brought out by the risk assessment.

- A large percentage of elderly persons and institutionalized persons are susceptible to extreme heat and extreme cold.
- The city offices of smaller jurisdictions have limited staffing to implement the actions.
- Maintenance of the wetlands is a concern when implementing the actions.
- A significant percentage of University students do not speak English as their native language.
- Approximately 29% of students in the local districts rely on the school lunch program which may indicate more economic need than previously thought.
- A portion of the population commutes to work in Topeka and Kansas City.
- Some schools do not have safe rooms incorporated into the building design.
- Mobile home parks and campers at Clinton Lake Park are vulnerable to tornadoes and other weather hazards.
- Invasive red cedars increase wildfire risk.
- Very little specific planning regarding Continuity of Operations Planning has been done in some jurisdictions.

CHAPTER 4 MITIGATION STRATEGY

44 CFR Requirement 201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section presents the mitigation strategy developed by the Hazard Mitigation Planning Committee (HMPC) based on the risk assessment. The mitigation strategy was developed through a collaborative group process and consists of goals, objectives, and mitigation actions. The following definitions are based upon those found in FEMA publication 386-3, Developing a Mitigation Plan (2002):

- **Goals** are general guidelines that explain what you want to achieve. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. They are usually long-term, broad, policy-type statements.
- **Objectives** define strategies or implementation steps to attain the identified goals and are specific and measurable.
- **Mitigation Actions** are specific actions that help achieve goals and objectives.

4.1 Goals and Objectives

The HMPC developed goals and objectives to provide direction for reducing hazard-related losses in Douglas County. These were based upon the results of the risk assessment and a review of goals and objectives from other state and local plans, specifically, the Kansas Hazard Mitigation Plan, 2007, the Douglas County Emergency Operations Plan, and the City of Eudora Hazard Mitigation Plan. This review was to ensure that this plan's mitigation strategy was integrated with existing plans and policies. Through a brainstorming process at its second meeting, the HMPC identified a variety of possible goals and then came to a consensus on four goals. Following the development of goals, the HMPC identified specific objectives to achieve each goal. Goals and objectives are listed below, but are not prioritized:

Goal #1: Increase capabilities within Douglas County entities to mitigate the effects of hazards by enhancing existing or designing and adopting new policies that will reduce the damaging effects of hazards.

Objective 1.1: Reduce repetitive property losses due to flood, wildfire, winter storms, and other hazards.

Objective 1.2: Protect critical facilities, infrastructure, and utility systems.

Objective 1.3: Encourage the incorporation of mitigation measures into repairs, redevelopment, and capital improvement projects for governments, businesses, educational institutions, and the public.

Objective 1.4: Identify funding opportunities for future mitigation measures.

Goal #2: Protect the most vulnerable populations, buildings, and critical facilities within Douglas County through the implementation of cost effective and technically feasible mitigation projects.

Objective 2.1: Educate property and business owners on affordable mitigation and preparedness measures that can be taken to reduce property loss.

Objective 2.2: Assure that vulnerable buildings and critical facilities within Douglas County are cataloged and that vulnerability assessments are completed for each identified facility.

Objective 2.3: Assure that vulnerable populations such as the elderly, homeless, low income or those with Limited English Proficiency are included in educational programs regarding preparedness or mitigation.

Objective 2.4: Enhance the capabilities to collect, analyze, update, and exchange data and information to support risk assessment and mitigation needs.

Goal #3: Improve the level of responder, government, business, and citizen awareness and preparedness for disaster.

Objective 3.1: Identify and develop needed training and exercises for targeted responder, government, and citizen audiences.

Objective 3.2: Strengthen outreach and partnerships with the private sector, nonprofit organizations and the public.

Objective 3.3: Improve public understanding of hazards and risk by providing public awareness, preparedness, and mitigation information through various channels of communication.

Goal #4: Develop programs to assure that response agencies, governments, educational institutions, and local businesses are able to operate during times of disaster.

Objective 4.1: Promote the development of emergency response plans, including continuity of operations plans, among local response agencies, governments, educational institutions and local businesses.

Objective 4.2: Provide education, training, and exercise opportunities for local entities to prepare for and test their ability to operate during times of disaster.

4.2 Identification and Analysis of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

At the second meeting of the HMPC, AMEC provided information about the types of projects typically seen in mitigation plans. A member of the Kansas Department of Agriculture's Division of Water Resources was available to answer questions regarding the National Flood Insurance Program. At the end of the second meeting, HMPC members were asked to complete a mitigation action worksheet for their jurisdiction and return those sheets to AMEC. The committee members were asked to take the forms back to their jurisdictions to discuss appropriate, achievable actions and to develop jurisdictional consensus on need. In order to help identify and analyze potential mitigation actions to achieve the mitigation goals, AMEC provided the HMPC with a packet of materials with information on types of mitigation actions.

AMEC collected these developed actions prior to the third meeting of the HMPC. The identified actions along with a listing of previously identified ideas for mitigation, key issues from the Risk Assessment, and a worksheet of the plan's goals and objectives were provided at the third meeting. Those jurisdictions, which had not previously identified actions brainstormed with other HMPC members to ensure that: (1) each jurisdiction participating in the multi-jurisdictional plan had at least one identified action, and (2) there were actions for each goal.

The HMPC was provided with the following list of categories of mitigation actions, which originated from the National Flood Insurance Program's Community Rating System, as well as definitions and examples for each category:

- **Prevention:** Administrative or regulatory actions or processes that influence the way land and buildings are developed and built
- **Property protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area
- **Structural:** Actions that involve the construction of structures to reduce the impact of hazard
- **Natural resource protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems
- **Emergency services:** Actions that protect people and property during and immediately after a disaster or hazard event
- **Public education and awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them

4.3 Implementation of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include an action strategy describing how the actions identified in paragraph (c)(2)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefits review of the proposed projects and their associated costs.

Once actions were identified, HMPC members were then asked to use a modified STAPLEE criteria worksheet to evaluate each project. The committee members were split into small workgroups of six to eight people. Each work group was given a portion of the actions to review and score using the modified STAPLEE criteria. Each group received information that had been submitted by the sponsoring jurisdiction for review. No jurisdiction was required to review its own projects. A copy of the modified scoring process is included in Appendix C. This process of identification and analysis of mitigation options allowed the HMPC to come to consensus and to prioritize recommended mitigation actions. Actions were prioritized by the modified STAPLEE score.

Emphasis was placed on the importance of a benefit-cost analysis in determining project priority; however, this was not a quantitative analysis. The Disaster Mitigation Act regulations state that benefit-cost review is the primary method by which mitigation projects should be prioritized. Recognizing the federal regulatory requirement to prioritize by benefit-cost, and the need for any publicly funded project to be cost-effective, the HMPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the Kansas Hazard Mitigation Plan. Cost-effectiveness will be considered in additional detail when seeking FEMA mitigation grant funding for eligible projects identified in this plan

Table 4.1 summarizes all of the prioritized mitigation actions and indicates which jurisdictions plan to implement them; it also provides information on the hazards and plan goals addressed.

Table 4.1 Mitigation Actions Developed by the Douglas County HMPC

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Purchase and install remote telemetry for rural water systems including controls for water tanks and pump stations.	2	UF	38 2012	\$ 58,000 / Rural Water District #2 / Planning This project seeks to purchase and install remote telemetry equipment for rural water systems within RWD #2. The project includes training for system operators and update of the emergency water supply plan.	RWD #2
Provide back up power generators for critical facilities in Eudora.	1, 2	TO ICE FL	38 2011	\$ unknown / City of Eudora / Planning The purpose of this project is to prioritize the provision of emergency back-up power generators for each critical facility in the City of Eudora. The purchase and installation of the generators is dependent on future funding and the project is considered long-term.	Eudora
Promote and continue to participate in the National Flood Insurance Program.	1	FL	37 2009	\$ staff time only / County and Cities / On-going This multi-jurisdictional project will promote the use of the National Flood Insurance Program in all participating areas. The project relies on educational materials prepared both by FEMA and the local entities. Public Service Announcements are utilized and publications are made available to homeowners. Local emergency management also provides on-site education at home owner association and other meetings when requested.	Douglas County Baldwin City Eudora Lecompton Lawrence
Purchase structures in the 100 year flood plain.	1	FL	36 2009	\$ unknown / City of Eudora Officials / Under consideration Project will involve purchasing structures located in the 100-year flood plain. All utilities will be properly disconnected, and the property will be graded and seeded for maintenance purposes. No structures will be allowed to be constructed on these properties except those allowed under open space uses.	Eudora
Provide additional support to the Community Rating System to raise the rating to the next level.	1	FL	35 2009	\$ staff time only / County and Cities / On-going The purpose of this project is to familiarize each NFIP participating community with the Community Rating System. The Kansas Department of Agriculture is a partner in this project. Once education has occurred, each community will take steps to raise its rating.	Douglas County Baldwin City Eudora Lecompton Lawrence

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Develop procedures to activate EAS and NWS all-hazard radios for chemical events and provide education on shelter-in-place related to a chemical release event.	1	HM	34 2010	\$ unknown / City of Eudora / Planning This project is designed to develop procedures for staff to utilize to activate the emergency alert system and the National Weather Service all-hazard radios in the event of a hazardous materials release in the Eudora area. A part of the program will be an educational program for citizens and responders related to shelter-in-place protocols.	Eudora
Provide educational materials for COOP Planning for small business and government.	4	ALL	34 2009	\$ unknown / City of Eudora / Planning This project involves provision of initial educational materials to small businesses and government departments within the City of Eudora related to Continuity of Operations Planning. FEMA guidelines will be utilized initially.	Eudora
Conduct regular emergency preparedness drills for school children at all levels, including tornado drills and fire evacuation drills.	3	FL TO?	33 On-going	\$ staff time only / School Districts / On-going This project involves conducting regular emergency preparedness drills for school children at all levels. The drills include tornado, fire, and general evacuation drills and are conducted at routine intervals. Corrective action is taken for each drill where problems are determined to exist.	USD #497 USD #343 USD #348 USD #491
Develop a plan for supporting medically fragile and special needs students at each school site during emergency events.	2	ALL	33 2010	\$ unknown / School Officials / Initial planning This project will develop a plan for supporting medically fragile and special needs students at each school site during emergency events. Dependent on funding, the project may only make recommendations or may implement recommendations.	USD #497 USD #343 USD #348 USD #491
Review and update emergency water supply plan.	1	ALL	32 2010	\$ staff time only / Rural Water District #2 / Planning This project involves the routine review and update of the emergency water supply plan. The Board of Directors will meet with the District Operator to complete the review and update.	RWD #2
Upgrade / repair / upsize 8 culverts within Baldwin City to prevent continued flooding issues.	2	FL	34 2009	\$ 565,000 / Baldwin City / In progress This project has identified 8 culverts within Baldwin City that are in need of upgrade/upsized or reconstruction. One has been completed, but 7 remain to be repaired. Additional funding is being sought.	Baldwin City

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Proactive management of tree and debris removal from roadways and elevation of roadways.	1, 2	TO WS ICE	33 On-going	\$ 60,000 / County, City and Township Officials / Pending funding The project will identify and prioritize roadways in need of elevation and those with large trees which are in need of trimming prior to winter conditions. The project will seek to gather assistance from local citizen volunteers to assist with the process.	Douglas County Baldwin City Eudora Lecompton Lawrence Clinton Township Lecompton Township Wakarusa Township
Provide homeowner education on wildfire mitigation in wildland-urban interface.	3	WF	33 2010	\$ 500 per workshop / Fire Departments / Planning This project will provide educational workshops for homeowners with property in wildland/ urban interface areas on steps they can take to defend their own property from wildfire. The Kansas Forest Service is a partner in the project.	Fire Departments Wakarusa, Palmyra, Eudora, Clinton, Kanwaka, Willow Springs, Lecompton Kansas Forest Service
Research stream bank set back ordinances.	1	FL	33 2010	\$ unknown / City of Eudora / Under development The purpose of this project is to research the possibility of enacting a stream bank set back ordinance for the City of Eudora.	Eudora
Update flood damage prevention ordinance to include new FEMA digital flood insurance rate maps.	1	FL	33 2009	\$ staff time only / Lawrence Stormwater / In progress This project will update the flood damage prevention ordinance to include the new FEMA digital flood insurance rate maps. Work on the new ordinance has already begun and it is expected to be completed in 2009.	Lawrence
Upgrade storm water pumps for Maple Grove drainage and additional pumping capacity to the existing pump station.	2	UF	32 2010	\$ unknown / Lawrence Stormwater / Pending funding This project seeks to upgrade the stormwater pumps for Maple Grove Drainage 2nd street pump station to provide additional pumping capacity. An infrastructure tax to support this project is on the November 2009 ballot.	Lawrence

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Develop a campus wide alert website to include emergency numbers and instructions for emergency preparedness.	2, 3	ALL	32 2009	\$ 2,250 / University of Kansas Emergency Management / Under development This project will design and develop a Campus Alert website. The site would post the current status of any emergency situation and would also provide educational materials regarding emergency response plans / procedures at the University.	University of Kansas
Construct a FEMA approved safe room at the proposed Baldwin Elementary school site.	2, 3	TO	32 2009 - 2010	\$ 1,000,000 / School Officials / Under development The purpose of this project is to install a FEMA approved safe room at the proposed Baldwin Elementary School – Primary Center that is planned for future development.	USD #348
Evaluate existing buildings for safe areas and prioritize replacements and upgrades to existing facilities.	2	TO ICE UF	31	\$ unknown / County, City, and School Officials / Planning The goal is to evaluate each school facility and other critical infrastructures to determine the need / feasibility for FEMA approved safe rooms, and obtain funding for those retrofits / new construction.	All Participating Jurisdictions
Develop and conduct a seminar for builders, developers, and home buyers on wind resistant and safe room construction.	3	TO WS	31 On-going	\$ unknown / County and City Officials / Planning Seminar for builders, developers, code officials and home buyers on wind resistant and safe room construction.	Douglas County Baldwin City Eudora Lecompton Lawrence
Provide hydrologic and hydraulic analysis and storm damage improvement designs for City of Eudora.	2	FL	30 2009	\$ unknown / City of Eudora / In progress The purpose of this project is to provide hydrologic and hydraulic analysis and storm damage improvements design for the City of Eudora.	Eudora
Construct a FEMA approved safe room for USD #491.	2	TO WS	30 2011	\$ 1,000,000 / USD #491 / In progress This project involves construction of a FEMA approved safe room in a school in Eudora. The school is under construction currently and this project was approved by FEMA following the approval of the City of Eudora Hazard Mitigation Plan.	USD #491

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Provide weather alert radios for all businesses and residential properties in Lecompton Township.	2, 3	ET FL TO ICE	29 2010	\$ 4,000 / Lecompton Fire District #1 / Under consideration This project will provide weather radios for all businesses and potentially all residential properties in Lecompton Township. Local fire department personnel will be utilized to deliver and set up the radios.	Lecompton Township Fire Department
Create a stream buffer ordinance.	1	FL	28 2009	\$ staff time only / Lawrence Stormwater / In progress The City of Lawrence is creating a stream buffer ordinance as a part of the flood damage prevention program to preserve open space through regulatory and non-regulatory methods.	Lawrence
Promote the early warning notification with the use of all hazard radios.	2, 3	ALL	27 On-going	\$ minimal advertising / County and City Officials / On-going The purpose of this project is to promote the use of early warning systems through the use of all-hazards weather radios. The project uses public service announcements and involves purchasing NOAA radios as funds are available.	Douglas County Baldwin City Eudora Lecompton Lawrence
Complete upgrades to the water system in Rural Water District #6.	2	ALL	27 2010	\$ 60,000 / Rural Water District #6 / In progress This project is a portion of a larger project that included refurbishing a pump station to install VFD pump drives and upgrade to an existing water tower. This portion seeks to upgrade a water main from 4 inch to 6 inch on Douglas County 438 from E 800 to E 600 roads.	RWD #6
Purchase software that allows management and essential staff to operate in a virtual office environment.	4	ALL	26 2010	\$ 229,500 / Douglas County Sheriff's Office / Initial planning The purpose of this project is to prepare local emergency responders in the event of a large scale emergency. The desired system will allow users to work remotely during the crisis and will allow essential emergency operations business activities to continue. The project includes an education component for system users.	Douglas County Sheriff's Office

Mitigation Action	Links to Goals	Hazards Addressed (see key at bottom)	STAPLEE SCORE / Completion Date	Projected Cost / Local Agency / Status / Project Description	Jurisdictions Participating in the Action
Study drainage issues throughout the county in flood prone areas, and make recommendations for flood control measures, flood management procedures, and low-water crossing improvements.	2	FL	25 2009	\$ unknown / City Planning Department / Under Consideration The purpose of this project is to provide an initial study of drainage issues throughout the county in flood prone areas, and make recommendations for flood control measures, flood management procedures, and low-water crossing improvements.	Baldwin City
Obtain and install a call notification system for use on Baker University campus.	2, 3	ALL	25 2010	\$ 10,000 / Baker University / Planning The purpose of this project is to obtain and install a call notification system for use on Baker University campus to be used to alert staff, residents, and students of issues related to disaster and inclement weather.	Baker University
Enhance existing GIS systems to support study of potential health related issues within existing floodplains.	1	FL	24 2010	\$ unknown / Health Department / Planning The purpose of this project is to enhance the existing GIS systems to support the application and study of septic systems and water wells within the flood plain.	Douglas County Baldwin City Eudora Lecompton Lawrence
Construct a FEMA approved safe room in all USD #343 school facilities as funding becomes available	2,3	TO ICE	24 2012	\$ 1,000,000 / School Districts / Initial planning The purpose of this project is to equip each school within the district with at least one FEMA approved safe room as funding for remodeling / new construction becomes available through grants or tax bonds.	USD #343
Construct a FEMA approved safe room in all USD #348 school facilities as funding becomes available.	2, 3	TO ICE	23	\$ 2,000,000 / USD #348 / Initial planning This project is a part of the district's 10 year improvement plan. The goal is to evaluate each school facility to determine the need / feasibility for a FEMA approved safe room, and obtain funding for those retrofits / new construction.	USD #348

Key for hazards:

• AG = Agricultural Infestation	• ET = Extreme Temperatures	• TO = Tornado
• DA = Dam & Levee Failure	• FL = Flood	• ICE = Winter Storm
• DO = Disease Outbreak	• FO = Fog	• WS = Wind Storm
• DR = Drought	• HS = Hail Storm	• WF = Wildfire
• EQ = Earthquake	• HM = Hazardous Materials	• UF = Utility Infrastructure
• ES = Expansive Soils	• LS = Land Subsidence	

4.4 Mitigation Actions in Support of the National Flood Insurance Program

Douglas County and the cities of Baldwin City, Eudora, Lecompton, and Lawrence are committed to continued participation and compliance with the National Flood Insurance Program (NFIP). Specific actions that were identified in support of the National Flood Insurance Program are summarized in Table 4.2 below:

Table 4.2 Specific Actions in Support of the NFIP

Action	Jurisdictions
Promote and continue to participate in the National Flood Insurance Program.	Douglas County Baldwin City Eudora Lecompton Lawrence
Purchase structures in the 100 year flood plain.	Eudora
Provide additional support to the Community Rating System to raise the rating to the next level.	Douglas County Baldwin City Eudora Lecompton Lawrence
Update flood damage prevention ordinance to include new FEMA digital flood insurance rate maps.	Lawrence

Specifics on implementation of each of the above actions can be found in Section 4.3.

CHAPTER 5 PLAN MAINTENANCE

This chapter provides an overview of the overall strategy for plan maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

5.1 Monitoring, Evaluating, and Updating the Plan

44 CFR Requirement 201.6(c)(4): The plan maintenance process shall include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

5.1.1 Hazard Mitigation Planning Committee

With adoption of this plan, the HMPC will be tasked with plan monitoring, evaluation, and maintenance of the plan. The participating jurisdictions and agencies, led by Douglas County Emergency Management, agree to

- Meet annually to monitor and evaluate the implementation of the plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Monitor funding opportunities to help the community implement the plan's recommended actions;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommend changes to the Douglas County Local Emergency Planning Committee and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The HMPC is an advisory body and will not have any powers over County, Cities, Townships, or District staff. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the County website.

5.1.2 Plan Maintenance Schedule

The HMPC agrees to meet annually during a regularly scheduled Local Emergency Planning Committee (LEPC) meeting to monitor progress and update the mitigation strategy. The Douglas County Emergency Manager will be responsible for initiating these plan reviews. Special invitations

will go to HMPC members who are not regular members of the LEPC. The reviews will occur in concurrence with the annual review of the emergency operations plan. In conjunction with the other participating jurisdictions, a written update of the plan must be approved by the Kansas Division of Emergency Management and FEMA Region VII per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000 and adopted by participating jurisdictions within a five-year period from the final approval of this plan unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

5.1.3 Plan Maintenance Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting

- Decreased vulnerabilities as a result of implementing the actions described in this plan,
- Increased vulnerabilities as a result of failed or ineffective mitigation actions, and/or
- Increased vulnerabilities as a result of new development or annexation.

Updates to this plan will:

- Consider changes in vulnerability due to action implementation,
- Document success stories where mitigation efforts have proven effective,
- Document areas where mitigation actions were not effective,
- Document any new hazards that may arise or were previously overlooked,
- Incorporate new data or studies on hazards and risks,
- Incorporate new capabilities or changes in capabilities, and
- Incorporate growth and development-related changes to inventories.

In order to best evaluate any changes in vulnerability as a result of plan implementation, a representative from the jurisdiction identified in each mitigation action will be responsible for tracking and reporting on action status. The representative will also provide input on whether the action as implemented meets the defined objectives and has been successful in reducing vulnerabilities. If the action does not meet identified objectives, the jurisdiction will determine what additional measures may be implemented, and an assigned individual will be responsible for defining action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.

Changes will be made to the plan to accommodate actions that have failed or are not considered feasible after a review of their adherence to established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be enacted through written changes and submissions as deemed appropriate and necessary by the Hazard Mitigation Planning Committee. Any changes to the plan will be approved by the governing boards of the participating jurisdictions.

5.2 Incorporation into Existing Planning Mechanisms

44 CFR Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. Based on the capability assessments of the participating jurisdictions, communities in Douglas County will continue to plan and implement programs to reduce loss of life and property from hazards. This plan builds upon the momentum developed through previous related planning efforts and mitigation programs, and recommends implementing actions, where possible, through the following means:

- General or master plans of participating jurisdictions
- Douglas County Emergency Operations Plan
- Capital improvement plans and budgets
- Other community plans within the County, such as water conservation plans, storm water management plans, and economic development plans

HMPC members involved in updating these existing planning mechanisms will be responsible for integrating the findings and actions of the mitigation plan, as appropriate.

5.3 Continued Public Involvement

44 CFR Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

The update process provides an opportunity to publicize success stories from the plan's implementation and seek additional public comment. Information will be posted on Douglas County's website following the annual review of the mitigation plan. A public comment period on plan maintenance and updating will be held during the update period. When the HMPC reconvenes for the update, it will coordinate with all stakeholders participating in the planning process, including those who joined the HMPC after the initial effort, to update and revise the plan. Public notice will be posted and public participation will be invited, at a minimum, through press releases to local media outlets.