

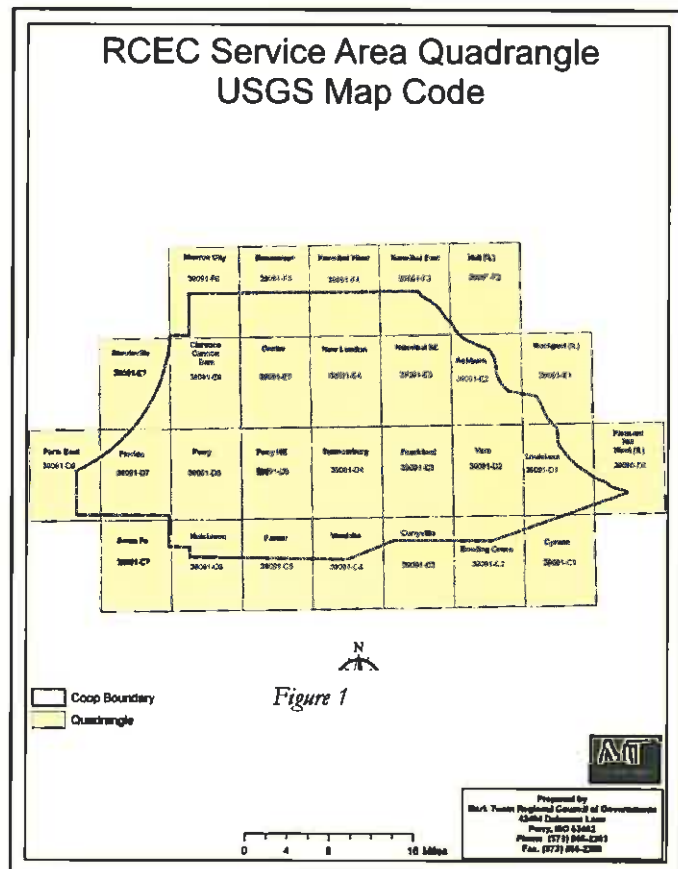
**Section 1: Introduction**

In 1936, the Ralls County Electric Cooperative (RCEC) was formed for the purpose of supplying reasonably priced electricity to its member owners. In the early years of the RCEC, members were actively involved in bringing electricity to the countryside. Today, professional crews clear the rights of ways and build electric lines. In addition to electricity, RCEC sells water heaters, heat pumps, surge protection, grills and also participates in energy conservation programs. In 2003, the Cooperative formed Ralls Technologies, which provides high speed Internet service to rural Northeast Missouri. The Cooperative also recently formed a not for profit organization, the Ralls Community Foundation, to assist other public and not for profit entities. Headquarters for the RCEC are located in New London, Missouri. Service is provided to customers in five counties in Northeast Missouri that include Audrain, Marion, Monroe, Pike and Ralls. A nine member board of directors provides direction for the cooperative.

The RCEC service territory consists of approximately 2,240 miles of energized line which serves customers in Audrain, Marion, Monroe, Pike and Ralls counties. Figure 1 depicts the geographic boundaries of the cooperative in relation to USGS local quadrangles within the state of Missouri. (Map sources: *www.usgs.gov*, *Association of Missouri Electric Cooperatives*, *Ralls County Electric Cooperative*.)

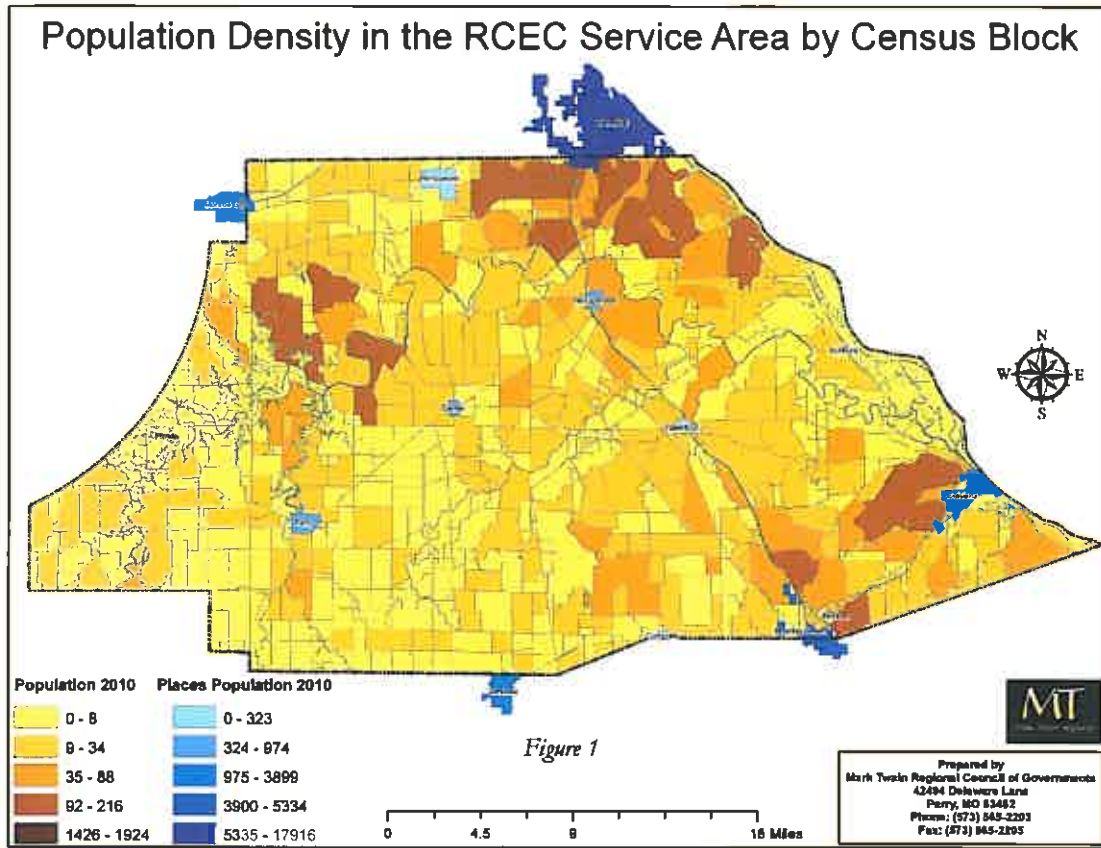
The RCEC currently has 6,523 connected meters and exceeds 6,000 members in the five county service area. Residential customers account for 80.7% of memberships (4,920 members) while non-residential customers make up the remaining 19.3% (1,176 members). Table 1.1 provides the summary of metered customers by county.

County	Number of meters
Audrain	56
Marion	78
Monroe	973
Pike	714
Ralls	4,701



RCEC's average daily customer usage is 37 kilowatt-hours (kWh). During 2010, the annual total usage of RCEC customers was 13,150kWh of service. Population

density for the cooperative service area is depicted in Figure 2 (Map source: U.S. Census 2010).



**Section 2: Planning process:**

The Missouri Association of Councils of Government and the Mark Twain Regional Council of Governments (MTRCOG) formed a partnership with the Association of Missouri Electric Cooperative and entered into a contract with the MTRCOG to facilitate a hazard mitigation planning process for RCEC. On February 4, 2011, an initial meeting was held as part of a regional kick-off meeting for Northeast and Central Missouri. This informational meeting provided the basic responsibilities for each agency and allowed for initial discussion concerning the project timelines, data collection and other pertinent topics.

Throughout the months of August and September, the RCEC office in New London was the location for three additional planning meetings. Table 1.2 summarizes the attendees and topics of each meeting. Meeting minutes are available in the chapter appendix.

Table 1.2 RCEC Planning Meeting Synopsis		
Meeting Date	Attendees, Title, Organization	Topics of discussion
August 16, 2011	Daniel Strode, Manager RCEC Chris Gaines, Line Superintendent, RCEC Judy Kinder, Admin. Asst., RCEC Vikki Stuart, Cashier, RCEC Kelly Mundle, Accountant, RCEC Robin Fitzgerald, Director, MTRCOG Cindy Hultz, Fiscal Officer, MTRCOG	RCEC business structure Customer information Critical facilities information Asset inventory by type and location Data collection assignments
September 7, 2011	Daniel Strode, Manager RCEC Chris Gaines, Line Superintendent, RCEC Judy Kinder, Admin. Asst., RCEC Vikki Stuart, Cashier, RCEC Kelly Mundle, Accountant, RCEC Robin Fitzgerald, Director, MTRCOG Cindy Hultz, Fiscal Officer, MTRCOG	Data collection review Current mitigation strategies Establishment of goals, actions, and objectives
September 22, 2011	Chris Gaines, Line Superintendent, RCEC Judy Kinder, Admin. Asst., RCEC Vikki Stuart, Cashier, RCEC Kelly Mundle, Accountant, RCEC Robin Fitzgerald, Director, MTRCOG Cindy Hultz, Fiscal Officer, MTRCOG	Method of prioritization Prioritization of goals, actions, and objectives

*Public Involvement*

As with all public hazard mitigation plans, public involvement was encouraged through a variety of methods. Ralls County REC posted their local chapter on the company’s website, inviting both cooperative members and the general public to provide comment. Print copies of the chapter were also made available upon request through the local office. Comments from neighboring jurisdictions were also solicited using the standardized AMEC letter which was mailed to the appropriate contacts including:

- Audrain County Commission,
- Marion County Commission,
- Monroe County Commission,
- Pike County Commission, and
- Ralls County Commission.

The RCEC provides service to critical facilities that include water providers/distributors, nursing homes, group homes, emergency services, telecommunications, and schools that were invited to participate in the public comment period.

**Section 3: Asset inventory**

Ralls County Electric Cooperative has a wide variety of assets. Real estate owned by the company includes office buildings, warehouses, garages and other outbuildings throughout the service area. Twenty-six vehicles provide access to customers and infrastructure. RCEC does not own any electric generation or transmission infrastructure. Approximately 1,460 miles of distribution lines are owned and maintained by RCEC. Table 1.3 provides information concerning total asset valuation.

Table 1.3	RCEC Inventory Valuation Summary	
Asset	Total Replacement Cost	Cost breakdown
Total RCEC Assets	\$132,241,567	Buildings and vehicles - \$5,732,343 Overhead assets - \$121,251,994 Underground assets - \$5,257,230
Distribution Lines	\$105,633,500 OH \$4,817,500 UG	OH Single-phase lines - \$70,323,500 UG Single-phase lines - \$2,749,500 OH Three-phase lines - \$35,310,000 UG Three-phase lines - \$2,068,000
Supporting Infrastructure	\$ 15,618,494 OH \$439,730 UG	OH Meters - \$218,491 UG Meters - \$17,280 Poles - \$8,370,833 OH Transformers - \$4,250,000 UG Transformers - \$422,450 Guys/Anchors - \$938,206 Cross-arms - \$232,514 Regulators - \$281,200 SP Oil-Circuit Reclosures - \$892,250 TP Oil-Circuit Reclosures - 265,500 Capacitors - \$25,500 Auto Transformers - 144,000
Office Buildings	\$1,840,000	
Warehouses	\$1,952,842	
Vehicles	\$1,939,501	
<i>Source: Internal RCEC Accounting and Insurance records, 2011</i>		

Ensuring quality distribution to its customers, Ralls County Electric Cooperative maintains not only distribution lines, but also the supporting infrastructure as well. Table 1.4 includes a list of asset types, emergency replacement cost per unit or mile, the asset inventory by service county, and total infrastructure numbers.

Asset	Emergency Replacement Cost per unit or mile	Number of units or miles: Audrain	Number of units or miles: Marion	Number of units or miles: Monroe	Number of units or miles: Pike	Number of units or miles: Ralls	Total number of units or miles:
Meter	\$36.15/unit	56 OH 0 OH	75 OH 3 UG	777 OH 196 UG	685 OH 29 UG	4,451 OH 250 UG	6,044 OH 478 UG
Pole	\$306.95/unit	300	300	3,000	4,000	19,671	27,271
SP*** distribution line	\$65,000/mile OH (\$12.31/foot OH) \$65,000/mile UG (\$12.31/foot UG)	17.8 OH 0 OH	6.9 OH .3 UG	122.7 OH 13.5 UG	226 OH 3.7 UG	708.5 OH 24.8 UG	1,081.9OH 42.3 UG
TP**** distribution line	\$110,000/mile (\$20.83/foot OH)	9.4 OH 0 OH	.4 OH .1 UG	44.7 OH 11.2 UG	50 OH 0 UG	216.5 OH 7.5 UG	321OH 18.8 UG
Transformers	\$850 OH \$850 UG	40 OH 0 UG	100 OH 3 UG	860 OH 201 UG	1,000 OH 30 UG	3,000OH 263 UG	5,000OH 497 UG
Guys/anchors	\$44.45/unit	75	100	1,000	1,500	18,432	21,107
Cross-arms	\$28.83/unit	50	7	2,570	738	4,700	8,065
Regulators	\$7,600/unit	0	0	6	4	27	37
Oil Circuit Reclosures	\$2,150 SP/unit \$17,700 TP/unit	6 SP 4 TP	1 SP 0 TP	37 SP 0 TP	30 SP 0 TP	341SP 11 TP	415 SP 15 TP
Capacitors	\$500/unit	3	0	4	4	40	51
Auto Transformers	\$8,000/unit	0	0	0	3	15	18
Total replacement value by county		\$2,409,084 OH 0 UG	\$679,093 OH \$33,158 UG	\$14,818,131 OH 2,287,435 UG	\$22,501,414 OH \$267,048 UG	\$80,844,271 OH \$2,669,588 UG	\$121,251,994 OH \$5,257,230 UG

#### Section 4: Identified Hazards and Risk Assessment Methodology

The natural hazards in Northeast Missouri can vary dramatically with regard to intensity, frequency, and the scope of impact. Some hazards, like earthquakes, happen without warning and do not provide any opportunity to prepare for the threat. Other hazards, such as tornadoes, flooding, or severe winter storms, provide a period of warning which allows for public preparation prior to their occurrence. Regardless, hazard mitigation planning can lessen the negative impact of any natural disaster regardless of the onset time. The following natural hazards have been identified as potential threats for the service region of the Ralls County Electric Cooperative:

- Tornadoes
- Severe Thunderstorms, Hail, and High Winds
- Flood and Levee Failure
- Severe Winter Weather
- Earthquakes
- Dam Failure

Likewise, a number of hazards may be eliminated from consideration in their local plan due to the state's geographic location including tsunamis, hurricanes, coastal storms, volcanic activity, avalanche, and tropical storms. Additionally, a number of hazards may be eliminated specifically for RCEC because of asset types and geographic location in the state of Missouri. Those hazards eliminated for the RCEC service region include:

- Drought
- Heat Wave
- Severe land subsidence
- Landslides
- Wildfires

Although drought can potentially impact central Missouri, water availability does not directly impact the delivery of electric service to RCEC customers. Similarly, heat wave has been eliminated. Though it may result in additional usage and potentially tax the system, heat waves do not usually cause infrastructure damage to cooperative assets. The results of a heat wave in the RCEC service area may be considered cascading events rather than damage caused directly by the hazard itself. Land subsidence and landslides have also been eliminated based upon local soil structure categorization by the USGS. Limestone, carbonate rock, salt beds, and other naturally dissolving rock which are most susceptible to the formation of sinkholes do not form the basis of soil in the RCEC service region. Wildfires were eliminated due to the very minimal threat.

For the purpose of this risk assessment, the identified hazards for the RCEC service area have been divided into two categories: **historical and non-historical hazards**.

**Historical Hazards** are those hazards with a measurable previous impact upon the service area. Damage costs per event and a chronology of occurrences are

available. The associated vulnerability assessments utilize the number of events and cost of each event to establish an average cost per incident. For RCEC, hazards with historical data include tornadoes, severe thunderstorms/high wind, severe winter weather, and wildfire.

**Non-historical Hazards** are hazards with no previous record of impact upon the local service area. As such, the associated vulnerability assessments for each of these hazards will have an occurrence probability of less than 1% in any given year, but the extent of damage will vary considerably. For RCEC, hazards without historical data include earthquakes and dam failure.

### *Probability of Occurrence*

In determining the potential frequency of occurrences, a simple formula was used. For historical events, the number of recorded events for the service area was divided by the number of years of record. This number was then multiplied by 100 to provide a percentage. This formula was used to determine future probability for each hazard. For events that have not occurred, a probability of less than 1% was automatically assigned as the hazard cannot be excluded from the possibility of occurrence. Likewise, when discussing the probable risk of each hazard based upon historical occurrences, the following scale was utilized:

- Less than 1% chance of an event occurrence in any given year.
- 1-10% chance of an event occurrence in any given year
- 10-99% chance of an event occurrence in any given year
- Near 100% chance of an event occurrence in any given year

The number of occurrences was further refined to focus on damage-causing events. Those occasions which had reported damages were divided by the total number of recorded events to obtain a percentage of total storms which result in infrastructure damage. (Formula: Number of damage-causing events / total number of events = Percentage of occurrences which cause damage.)

### *Potential Extent of Damage*

Vulnerability Assessment matrices for each hazard are included on the following pages. These worksheets detail loss estimates for each hazard affecting the cooperative's service area. Loss estimates were calculated using the asset summary created by internal RCEC accounting records. Each hazard has a unique impact upon the service area, requiring each hazard to utilize a different valuation amount depending upon the level of impact. Non-historical hazards assume damage to all general assets. For Historical Hazards, assets were divided into two groups based upon historical impact which were utilized in the hazard damage analysis:

- Overhead infrastructure assets and buildings
  - Used for Tornado damage assessments

- Valued at \$126,984,337
- Overhead infrastructure assets only
- Used for:
  - Severe Thunderstorm / High Wind / Hail
  - Flood
  - Severe Winter Weather
- Valued at \$121,251,994

In addition, historical hazards with recorded damages were used to identify an average cost per event. (Formula: Total cost of damages / total number of events = Average damage cost per event.) When discussing the extent of potential damages for all hazards, the following scale was utilized:

- Less than 10% potential damages to total cooperative infrastructure
- 10-25% potential damages to total cooperative infrastructure
- 25-50% potential damages to total cooperative infrastructure
- More than 50% potential damages to total cooperative infrastructure

Regardless of hazard categorization, the following matrix (Table 1.5) will be utilized to identify the potential damage extent and likelihood of occurrence for each natural hazard type.

Table 1.5 Sample Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: _		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

In many instances, natural hazard events occur without causing significant damage to the cooperative’s infrastructure. The more significant impact of natural hazard episodes comes in the form of reported customer outages. The infrastructure may not be significantly harmed by an ice storm, but may result in prolonged and widespread outages in the cooperative’s service area. In considering the potential impact of a hazard, loss of function provides a more concise picture for comparison of events and geographic regions of the state. In addition to system damage, each hazard will be evaluated on the

average number of reported or estimated outages per event occurrence. (Formula: Average number of outages reported / Total number of customers = Average percentage of outages reported per event)

Table 1.6 Sample Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard:		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

**Section 5: Risk Assessment**

**A) Historical Hazards:**

*Tornadoes*

In the last 47 years, 34 tornadoes have been reported within the Ralls County Electric Cooperative boundaries. Figure 3 provides a pictorial representation of all recorded tornado touchdown sites and recorded path. (Data for map collected from NOAA.)

A data insufficiency exists, however, between 1968 and 1991 in both historical hazard records and cooperative records concerning damage estimates. For the purpose of this assessment, the years for which records exist for both data sets have been used. From 1996-2011, RCEC’s service area within the state of Missouri has experienced a total of twenty tornadic events. Using the previously described methodology, the probability of a tornadic event in the RCEC service area in any given year is 133% (20

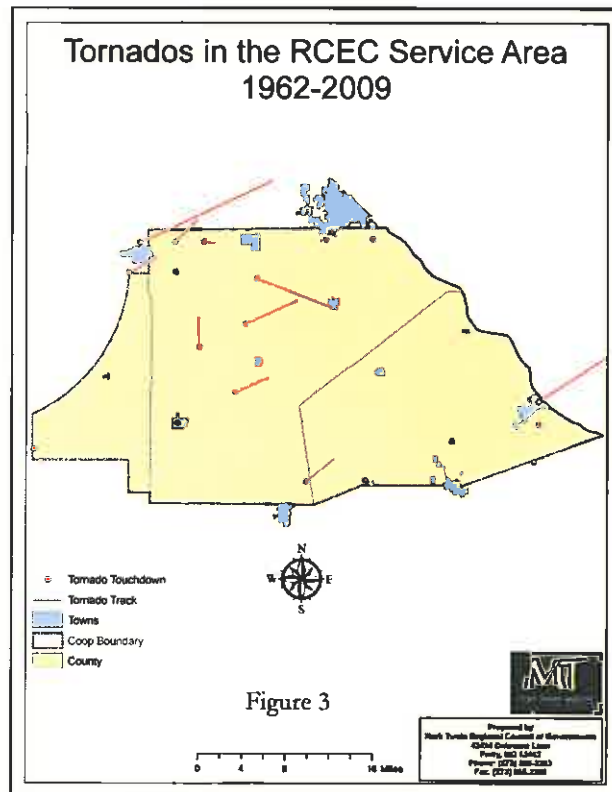


Figure 3

events / 15 years = 133%). Estimated cooperative material damages associated with each of these events were compiled by RCEC staff. Thirteen of the twenty occurrences caused damage to cooperative assets, resulting in a 65% probability that any given tornadic occurrence will produce damage (13 events / 20 occurrences = 65%). Table 1.7 provides a summary of the event date, EF-scale ratings, damage cost estimates and outages reported.

Date of event	EF Scale rating	Damage estimates	Outages Reported
2/29/00	F0	\$960	3
6/20/00	F0	\$1,280	4
5/24/04	F0	\$7,000	36
3/12/06	F0	\$1,600	5
4/02/06	F2	\$3,840	12
6/22/06	F0	\$640	2
3/01/07	F1	\$2,560	8
10/02/07	F0	\$960	3
5/30/08	F0	\$960	3
12/27/08	F1	\$4,160	13
5/15/09	F0	\$320	1
7/20/10	F0	\$5,440	17
2/27/11	F0	\$320	1

*Data provided based on internal RCEC records which reflect cost from the referenced event year.*

Based upon the last 15 years of historical event records, the average tornado to affect the cooperative will include an EF0 – EF2 rating, causing an average damage cost of \$2,310.77 per event (\$30,004/13 events = \$2,310.77). This averaged amount accounts for less than 1% of RCEC’s total overhead assets and building valuation (\$2,310.77/\$126,984,337 = 0.00002%). Table 1.8 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Tornado</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

An average of 3 customers reported outages during recorded tornadoes since 1996. When compared with the total number of customers served by RCEC it can be projected that less than 1% of all customers may report outages during any given tornadic event.

Table 1.9 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

<b>Table 1.9</b> <b>Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix</b> <b>Hazard: <u>Tornado</u></b>		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

*Severe Thunderstorms, High Wind, and Hail*

From 1996-2011, RCEC’s service area within the state of Missouri has experienced a total of 85 hail events and 116 thunderstorm/high wind events. Therefore, the probability of a hail event in the RCEC service area in any given year is near 100% (85 events / 15 years = 567%) while the probability of a thunderstorm/high wind event in any given year is 100% (116 events / 15 years = 773%). RCEC staff reported that there were no material damages or outages associated with hail events from 1996 to 2011, resulting in a less than 1% probability that any given hail event will damage cooperative assets. (0/85=0%)

Table 1.10 provides a summary of those Thunderstorm/High Wind events which caused damage to cooperative infrastructure by date, cost estimate of damage and reported outages. Sixty-six of the 116 occurrences caused damage to cooperative assets, resulting in a 56.9% probability that any given thunderstorm/high wind occurrence will produce damage. (66 /116 = 56.9%)

Sixty-six of the 116 occurrences caused damage to cooperative assets, resulting in a 56.9% probability that any given thunderstorm/high wind occurrence will produce damage. (66 /116 = 56.9%)

Based upon historical records, the average Thunderstorm/High Wind event to affect the cooperative will cause an average damage cost of \$1,842 (\$121,560/ 66 events = \$1,842) This averaged amount accounts for less than 1% of RCEC’s total overhead asset valuation (\$1,842 /\$121,251,994 = 0.00002%)

Table 1.10 RCEC Thunderstorm/High Wind Event Summary					
Event date	Damage estimates	Outages reported	Event date	Damage estimates	Outages reported
2/29/00	\$1,280	4	6/08/05	\$2,240	7
3/26/00	\$1,280	4	6/13/05	\$1,600	5
4/20/00	\$2,240	7	8/13/05	\$960	3
5/08/00	\$960	3	8/28/05	\$960	3
5/26/00	\$1,920	6	3/11/06	\$960	3
6/04/00	\$960	3	3/30/06	\$960	3
6/25/00	\$1,280	4	5/29/06	\$2,880	9
7/02/00	\$2,880	9	6/10/06	\$320	1
8/07/00	\$7,000	33	7/13/06	\$1,280	4
9/11/00	\$960	3	8/18/06	\$3,200	10
3/13/01	\$640	2	8/26/06	\$1,280	4
7/03/01	\$640	2	3/31/07	\$1,920	6
9/18/01	\$320	1	6/07/07	\$640	2
3/09/02	\$1,280	4	8/12/07	\$1,920	6
5/06/02	\$3,200	10	8/16/07	\$1,280	4
5/08/02	\$2,560	8	7/02/08	\$960	3
7/09/02	\$5,760	18	7/08/08	\$1920	6
7/22/02	\$640	2	7/21/08	\$1,600	5
5/09/03	\$2,880	9	7/27/08	\$1,600	5
6/25/03	\$3,520	11	7/29/08	\$960	3
7/09/03	\$2,560	8	8/28/08	\$3,840	12
7/18/03	\$1,920	6	3/08/09	\$1,920	6
7/28/03	\$960	3	6/19/09	\$5,120	16
8/28/03	\$1,600	5	6/23/09	\$640	2
9/26/03	\$4,160	13	8/19/09	\$640	2
5/27/04	\$1,920	6	6/13/10	\$3,840	12
5/31/04	\$1,600	5	6/23/10	\$960	3
7/05/04	\$1,280	4	7/18/10	\$2,240	7
8/25/04	\$3,840	12	7/19/10	\$2,240	7
8/26/04	\$2,560	8	9/18/10	\$1,600	5
9/15/04	\$640	2	9/21/10	\$960	3
10/29/04	\$320	1	10/25/10	\$320	1
4/20/05	\$640	2	10/26/10	\$1,600	5

*Data provided based on internal RCEC records which reflect cost from the referenced event year.*

Table 1.11 demonstrates the probability of occurrence in conjunction with the potential extent of damage for both hail and thunderstorm/high wind events.

Table 1.11 Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Thunderstorm/High Wind/Hail</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

An average of 6 customers reported outages during recorded hail, thunderstorm, and high wind events since 1996. When compared with the total number of customers served by RCEC, it can be projected that less than 1% of all customers may report outages during any given hail, thunderstorm, or high wind event. Table 1.12 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

Table 1.12 Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: <u>Thunderstorm/High Wind/Hail</u>		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages	Hail		Thunderstorm / High Wind	
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

*Flood and Levee Failure*

Flood and levee failure carries very minimal ongoing potential threat to the existing infrastructure of the Ralls County Electric Cooperative. Approximately 6% of the cooperative service area is located directly within the 100 year floodplain. Figure 4 below depicts the 100 year floodplain in relation to the cooperative’s boundaries. (Map sources: FEMA National Flood Hazard Layer – Missouri). Currently, inundation data for levee failure is lacking due to issues surrounding mapping, appropriate models, and its close association with flooding events. Figure 5 below provides the location of known state and federal levees within the cooperative’s boundaries. (Map sources: US Topographic Map and MSDIS)

From 1996-2011, RCEC’s service area has experienced 16 flooding events. Currently, no data concerning levee failure damage can be separated from flood damage data. Therefore, the probability of a flood/levee failure event affecting the cooperative assets in any given year is 100% (16 events / 15 years = 107%). Estimated material damages associated with each of these events were compiled by RCEC staff. Table 1.13 summarizes flood event dates by month, damage cost estimates and reported outages. One of the 16 occurrences caused damage to the cooperative assets, resulting in a 6.3% probability that any given flood occurrence will produce damage (1/16= 6.25%)

Table 1.13		RCEC Flood Event Summary
Date of event	Damage estimates	Outages Reported
7/14/08	\$15,000	15

Flood and levee failure events vary widely based upon numerous factors including, but not limited to, annual precipitation and extent of levee damage. Not all events, however, are extensive as evidenced in Table 1.13. Based upon historical records, the average flood/levee failure event to affect the cooperative will cause an average damage cost of \$15,000 (\$15,000/1 event = \$15,000). This averaged amount accounts for less than 1% of RCEC’s overhead asset valuation (\$15,000/\$121,251,994 = .0001). Table 1.14

Table 1.14 Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Flood</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	≥ 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Fifteen customers reported outages during recorded flooding events since 1996. When compared with the total number of customers served by RCEC, it can be projected that less than 1% of all customers may report outages during any given flood event. Table 1.15 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

Table 1.15 Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Flood		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

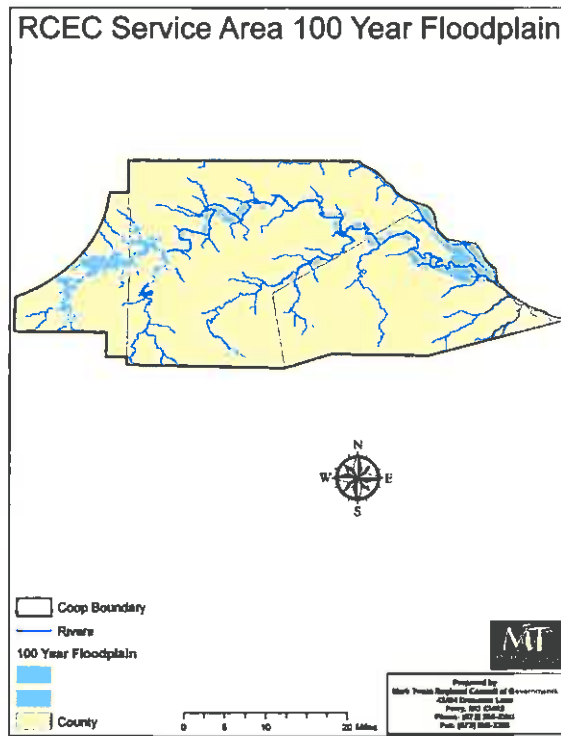
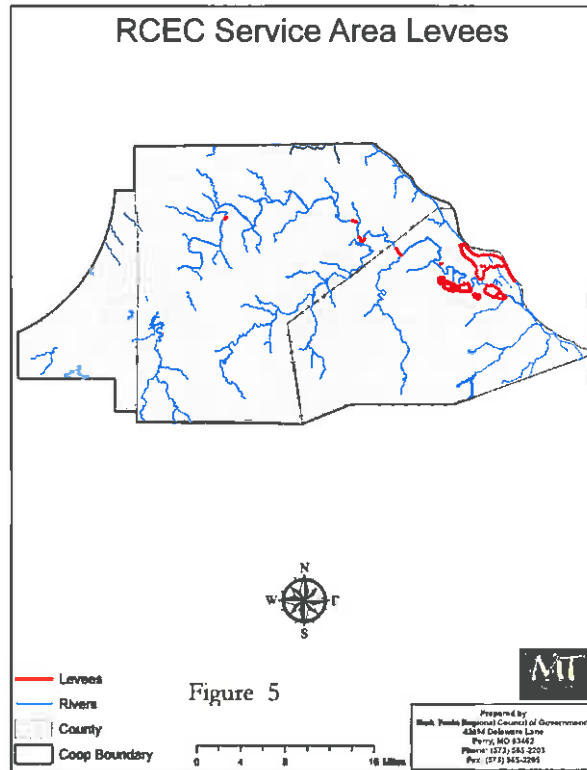


Figure 4



*Severe Winter Weather*

From 1996-2011, RCEC’s service area has experienced a total of 43 severe winter weather events, including significant snowfall and ice storms. Therefore, the probability of a severe winter weather event in the RCEC service area in any given year is near 100% (43 events / 15 years = 287%). Estimated material damages associated with each of these events were compiled by RCEC staff. Table 1.16 provides a summary of event dates, types, associated damage estimates, and reported outages. One of the 43 occurrences caused damage to cooperative assets, resulting in a 2.3% probability that any given severe winter weather occurrence will produce damage. (1 event / 43 occurrences = 2.3%)

Table 1.16 RCEC Severe Winter Weather Event Summary			
Event date	Event type	Damage estimates	Outages reported
12/08/07	Ice	\$65,000	5
<i>Data provided based on internal RCEC records which reflect cost from the referenced event year.</i>			

Based upon these historical records, the average severe winter weather event to affect the cooperative will cause an average damage cost of \$65,000 (\$65,000 / 1 event = \$65,000). This averaged amount accounts for less than 1% of RCEC’s total overhead asset valuation (\$65,000 / \$121,251,994= 0.05%). Table 1.17 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Table 1.17 Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Severe Winter Weather</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

An average of 5 customers reported outages during recorded severe winter weather events since 1996. When compared with the total number of customers served by RCEC, it can be projected that less than 1% of all customers may report outages during any given severe winter weather event. Table 1.18 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

Table 1.18 Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: <u>Severe Winter Weather</u>		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

*Wildfire*

The incidence of wildfire in the RCEC service area presents a unique risk assessment. Wildfire events have occurred in each of the five counties. According to the Missouri Department of Conservation, Audrain, Marion, Monroe, Pike and Ralls Counties have

experienced wildfires between 2004 and 2008. Table 1.19 summarizes the incidences of wildfire within the five counties. Therefore, the probability of a wildfire event in the RCEC service area in any given year is near 100% (230 / 4 years = 5,750%). However, for the purposes of this assessment, wildfire and its associated impacts cannot be eliminated from the realm of possibility.

**Table 1.19 Wildfire summary by county**

County	# of Wildfires, 2004-08	Average Annual # of Wildfires	Likelihood (1-5)	Acres Burned	Average Annual Acres Burned	Total Buildings Damaged	Vulnerability
Audrain	43	8.6	1	134.5	27	0	Low
Marion	55	11	1	579.45	116	0	Medium-Low
Monroe	53	10.6	1	1,012.5	203	0	Medium-Low
Pike	50	10	1	413.7	83	1	Low
Ralls	29	5.8	1	285	57	0	Low
Totals	230	46.0	1	2,425.15	486	1	Medium-low

*Source: Missouri State Hazard Mitigation Plan, 2010*

The potential extent of damage caused by wildfire is difficult to determine. Like earthquakes and dam failure, wildfires have had no measurable impact upon the RCEC service area. To date, 230 fires have burned a total of 2,425.15 acres for an average of 10.5 acres affected per event. RCEC sustained no damage related to wildfires in its service area during this time period. Cooperative assets are located throughout the service area rather than being located at a single central site. With an average of 10 acres per fire in the service area, it is unlikely that infrastructure damage would exceed 5% based upon asset location and unlikeliness of an uncontrollable fire. This initial assessment assumes a limited impact upon electrical distribution infrastructure of less than 10% (Table 1.20). Further study will be required to create a model for damage assessments related to wildfire.

**Table 1.20**

Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Wildfire</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

No customers have reported outages during recorded wildfires between 2004 and 2008. When compared with the total number of customers served by RCEC, it can be projected that 0% of all customers may report outages during any given wildfire event. Table 1.21 demonstrates the probability of occurrence with the potential extent of impact upon local customers.

Table 1.21 Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: <u>Wildfire</u>		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

**B. Non-historical Hazards**

*Earthquakes*

The closest source of earthquake risk in central Missouri is the New Madrid Fault located in extreme southeast Missouri, which has, according to many experts, the potential to produce the largest earthquakes in North America. Undoubtedly, this fault has the potential to affect the RCEC service area in its entirety. In addition, there have been several small, virtually undetectable earth movements in the region in recent history, which may or may not be attributed to the aforementioned fault lines or other, very small faults located nearby.

The New Madrid fault has the potential to cause damage throughout the state of Missouri, including the RCEC service area. Scientists from the U.S. Geological Survey (USGS) and the Center for Earthquake Research and Information (CERI) at the University of Memphis have estimated the probability of a magnitude 6.0 or greater earthquake from the New Madrid Fault is 25-40 percent through the year 2053. The probability of an earthquake increases with each passing day.

The projected earthquake intensity ratings for the cooperative region changes based upon the Modified Mercalli Scale. Given a New Madrid earthquake with a 6.7 rating, three of the service area counties (Marion, Ralls, Pike) would experience a Level VII intensity,

while the remaining two counties (Monroe and Audrain) would experience a Level VI intensity characteristics. In the event of an earthquake with a 7.6 rating, Monroe and Audrain Counties would experience a Level VII intensity, while Ralls, Marion and Pike Counties would experience intensities of VIII. Subsequently, an earthquake of 8.6 magnitude would result in Monroe and Audrain Counties experiencing intensities of VIII. Consequently, intensity levels in Ralls, Marion and Pike Counties would be IX. Substantial damage would result in the entire service area should a magnitude 8.6 earthquake occur.

In the event of an earthquake with a VI rating, the RCEC service area would most likely experience minor building damage as well as damage to the electrical distribution system. This damage, however, would most likely be relatively minimal and localized when compared with the VII, VIII and IX intensities. Distribution lines overhead and underground could become disconnected or severed, and transformers could be damaged and damage to structures will most likely be severe. Though the probability of occurrence is very small, the potential extent of damage could significantly impact both the cooperative and its customers as demonstrated in Table 1.22

Table 1.22 Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Earthquake</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

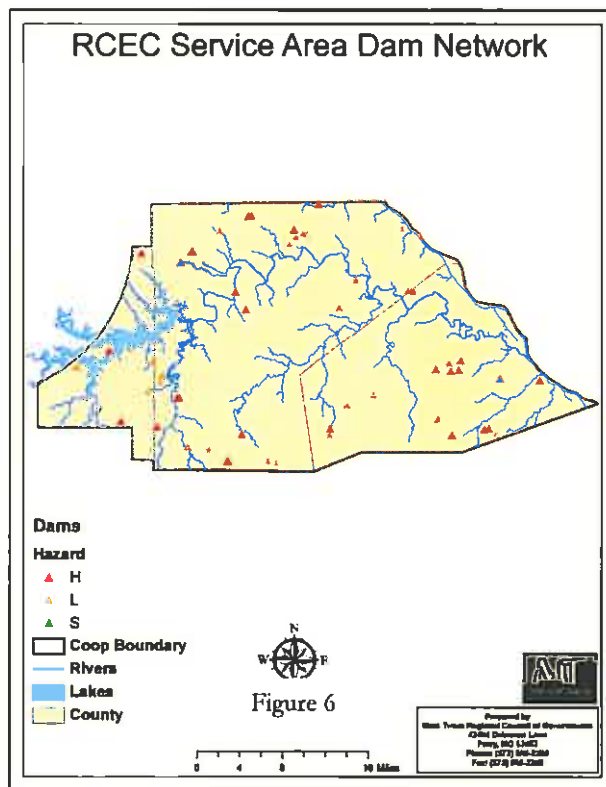
Based upon information from CERI, FEMA, and SEMA, it may be estimated that 610 customers could report outages related to an earthquake event. When compared with the total number of customers served by RCEC, it can be projected that 10% of all customers may report outages during any given seismic event. Table 1.23 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Earthquake		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

*Dam Failure*

Like earthquakes, dam failures have had no measurable impact upon the RCEC service area to date. According to Missouri DNR’s Dam Safety Division, 55 dams currently exist within the cooperative boundaries: 31 in Ralls County, 17 in Pike County, and seven in Monroe County. Of these dams, two in Ralls County, three in Pike County and one in Monroe County are regulated by the state due to the fact that they are non-agricultural, non-federal dams which exceed 35 feet in height. Figure 6 shows the locations of all known dams located within RCEC’s service area.

(Map sources: [www.msdis.missouri.edu](http://www.msdis.missouri.edu))



Twenty-six dam failures have occurred within the state of Missouri over the past 100 years. However, no such event has occurred within or near the cooperative’s boundaries. However, for the purposes of this assessment, dam failure and its associated impacts cannot be eliminated from the realm of possibility. In order to allow for a risk assessment, the probability of this event has been included as less than 1%.

Table 1.24 Ralls County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: <u>Dam Failure</u>		Probability of Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10- 99% chance in any given year	Near 100% probability in any given year
Potential Extent of Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

Determining the potential extent of dam failure is currently impossible due to a lack of data concerning inundation zones. Further study concerning existing dams and their impact is required to make a more comprehensive assessment of potential damages. This initial assessment assumes a limited impact upon downstream electric distribution infrastructure of less than 10% for both infrastructure damage and service interruption. (Tables 1.24 and 1.25)

Table 1.25 Ralls County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: <u>Dam Failure</u>		Probability of Damage-causing Hazard Occurrence			
		Less than 1% in any given year	1-10% chance in any given year	10-99% chance in any given year	> Near 100% probability in any given year
Potential Extent of Impact	Less than 10% of customers report outages				
	10-25% of customers report outages				
	26-50% of customers report outages				
	More than 50% of customers report outages				

## Section 6: Mitigation strategies

### *Previous efforts at mitigation*

For organizations like RCEC, mitigation is considered to be part of prudent business operations. In order to ensure the delivery of a quality product and minimize service interruptions, a number of mitigation strategies are continually utilized. Routine

maintenance and upgrades to existing equipment are completed as part of daily tasks. Vegetation management is utilized to limit the cascading effects of natural hazards. Safety and reporting information are disseminated to the public through various types of media. Mutual aid agreements and partnerships create relationships which provide for future support in the event of a natural disaster.

Additionally, mitigation is considered prior to any expansion of service into special hazard areas. Before any service is built, it is first “staked out” in coordination with local builders and property owners. This process, completed by the Line Superintendent and contracted engineers, identifies and addresses foreseeable hazards and safety issues before any new service lines area constructed. USDA-RUS specifications regarding operation and safety are utilized in every step of the process. Steps are taken to practically minimize the exposure of equipment to loss due to foreseeable hazards, particularly flooding. Customers who reside in the floodplain are not charged for repairs or losses associated with flooding unless they purposefully destroy or restrict the cooperative from protecting their distribution system assets.

#### *Existing and potential resources*

As stated above, mitigation is a key component of good business practices. Ralls County Electric Cooperative includes mitigation strategies as part of regular work activities to ensure service with minimal interruptions. Funding for these activities is provided through the cooperative’s normal budgetary process for maintenance.

In order to expand mitigation efforts beyond normal maintenance, it is likely that RCEC will need to seek outside funding sources. These may include private, state, or federal programs which provide grant and loan funding. Upon passage of this plan, RCEC will be eligible for funding through FEMA in the following categories:

- Hazard Mitigation Grant Program
- Flood Mitigation Assistance Program
- Pre-Disaster Mitigation Program
- 406 Stafford Act

#### *Development of goals, objectives, and actions*

Establishing mitigation goals, objectives, and actions for a business entity requires a slightly different approach than public agencies. Certainly, a number of similarities exist; both entities must consider which hazards most commonly occur and have the greatest potential for causing disruption to members or residents. They must also consider which types of actions will maximize benefits and minimize costs, how mitigation strategies will be implemented, who will enforce implementation, and how the overall plan will be maintained and updated.

The RCEC mitigation planning committee, with assistance from MTRCOG staff, worked to identify goals, actions, and objectives which addressed hazard mitigation issues. The

committee first identified ongoing mitigation strategies as well as potential strategies which seek to improve service and limit disruptions resulting from natural hazards. Action items were then analyzed for common characteristics and summarized to create nine objectives. Likewise, these nine objectives were grouped into similar categories and used as the basis for the four overarching goals. Table 1.23 provides a simple synopsis of the goals and objectives before prioritization.

Traditionally, the STAPLEE (Social, Technical, Administrative, Political, Legal, Environmental, and Economic) method is used to prioritize mitigation actions. These categories, however, do not necessarily align with the private sector in the same way they are applicable to governmental agencies. A number of action items could be included with multiple goals and objectives, for example. As a result, the committee chose to use a different method to prioritize their mitigation strategy.

Table 1.26	RCEC goals and objectives
Identified Goals	Identified Objectives
Goal 1: Protect the health and safety of the community.	Objective 1: Prevent injury, loss of life, and damage to property.
	Objective 2: Reduce outage time to critical facilities.
Goal 2: Reduce future losses due to natural hazard events.	Objective 1: Protect and maintain existing infrastructure.
	Objective 2: Research and develop plans for future infrastructure improvements, seeking implementation where feasible.
	Objective 3: Research and develop plans for future communication and data collection improvements where feasible.
Goal 3: Improve emergency management capabilities and enhance local partnerships.	Objective 1: Improve assessment of outages and reduce response time.
	Objective 2: Create or maintain partnerships with outside agencies.
Goal 4: Continue to promote public awareness and education.	Objective 1: Utilize media resources to promote public education.
	Objective 2: Continue interaction with local schools and civic groups.

After identifying ongoing and potential action items, the committee created three priority tiers:

- **First tier** actions focus on physical infrastructure protection and improvements which ensure continued, quality service and seek to reduce power outages. These types of actions are the highest priority of RCEC.
- **Second tier** actions create and maintain working relationships to reduce and prevent the impact of power outages. These include improvements to safety and reporting information, mutual aid agreements, and other efforts which seek to expand and improve both customer service and disaster planning.
- **Third tier** actions identify potential projects for other system improvements. These include mapping efforts, technological improvements, and research related to the expansion of mitigation efforts.

Actions within each tier may be funded through regular budgetary methods or identified outside sources. Tables 1.27, 1.28, and 1.29 provide a list of action items by tier as well as the goals and objectives identified with each.

<b>Table 1.27 Prioritized Mitigation Actions for Ralls County Electric Cooperative – Tier 1</b>			
<b>Tier 1</b>			
<i>Action item:</i>	<i>Goal/Objective</i>	<i>Timeframe for completion</i>	<i>Cost-benefit score</i>
Add poles and line; change poles as needed, tighten hardware, perform routine maintenance and vegetation maintenance	Goal 1 / Objective 1 Goal 1/ Objective 2 Goal 2 / Objective 1	Ongoing	High Cost High Benefit Score: 7
Replace cross arms and shorten spans; perform annual inspection of poles and lines; add lightning arresters	Goal 1 / Objective 1 Goal 2 / Objective 1	Dependent upon funding	Low Cost Medium Benefit Score: 6
Implement new electronic reclosures; add new and larger conductors; convert overhead lines to underground lines or vise versa in areas of vulnerability; add alternate source wiring to reduce outage time; install new conductors and poles; upgrade to concrete or steel poles in some areas; install new electric reclosures and expand use of lightning arresters;	Goal 1 / Objective 1 Goal 1/ Objective 3 Goal 2 / Objective 1	Dependent upon funding	High Cost Medium Benefit Score: 4
Waterproof meters	Goal 2/ Objective 1	Dependent upon funding	High Cost Low Benefit Score: 1

**Table 1.28 Prioritized Mitigation Actions for Ralls County Electric Cooperative – Tier 2**

<b>Tier 2</b>			
<i>Action item:</i>	<i>Goal/Objective</i>	<i>Timeframe for completion</i>	<i>Cost-benefit Score</i>
Partner with county emergency management agencies to ensure power for local shelters, fuel stations, and public safety.	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 3 / Objective 2	Ongoing effort.	Low Cost High Benefit Score: 9
Increase holding of generators for use in critical assets	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 3 / Objective 2	Ongoing effort	Low Cost High Benefit Score: 9
Cooperate with local law enforcement and government officials to reduce the impact of power outages.	Goal 1 / Objective 1 Goal 3 / Objective 2	Ongoing effort.	Low Cost Medium Benefit Score: 6
Maintain mutual aid agreements with other rural electric cooperatives.	Goal 3/Objective 2	Ongoing effort.	Low Cost Medium Benefit Score: 6

**Table 1.29 Prioritized Mitigation Actions for Ralls County Electric Cooperative – Tier 3**

<b>Tier 3</b>			
<i>Action item:</i>	<i>Goal/Objective</i>	<i>Timeframe for completion</i>	<i>Cost-benefit</i>
Improve outage management using GIS system. GPS all infrastructure	Goal 2 / Objective 1 Goal 2/ Objective 2 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	High Cost Medium Benefit Score: 4
Implement IVR (integrated voice response ) system to improve outage reporting	Goal 3 / Objective 1	Dependent upon additional funding.	High Cost Low Benefit Score: 1
Monitor developments in data availability concerning the impact of dam failure and wildfire upon the RCEC service area through local, state and federal agencies	Goal 1/Objective 1 Goal 2/Objective 1	Ongoing effort	Low cost Low benefit Score: 3

## Section 7 – Plan Implementation and Maintenance

### *Plan incorporation*

The goals, objectives, and actions of the previous section identify both ongoing efforts at mitigation and potential methods for expanding efforts. The plan has been reviewed and adopted by the Board of Directors as part of the company's operations policy. This mitigation plan necessitates involvement from every RCEC employment level as the organization strives to ensure quality service to their customers.

### *Other Local Planning Mechanisms*

Beyond the RCEC plan, few planning mechanisms exist at the local level. The Missouri counties of Audrain, Marion, Monroe, Pike and Ralls each have a FEMA-approved Natural Hazard Mitigation Plan in place. County emergency management directors have Local Emergency Operations Plans which seek to mitigate the same hazards for residents. These same counties are also included in the Regional Transportation Plan (RTP) as well as a Comprehensive Economic Development Strategy (CEDS). RCEC's plan can be easily incorporated into these local plans and allow for coordination across agencies in the event of an emergency.

RCEC is located within the rural portions of third-class counties which are prohibited from enforcing building codes and zoning by the state of Missouri. They do not provide service to any municipality within these counties. Comprehensive plans and Capital Improvement plans do not exist inside of the RCEC service areas.

### *Plan Maintenance*

RCEC will conform to the requirements established by the Association of Missouri Electric Cooperatives (AMEC) for monitoring, evaluating, and updating the plan.

### *Continued Public Involvement Opportunities*

RCEC will conform to the requirements established by the Association of Missouri Electric Cooperatives (AMEC) for continued public involvement. Opportunities for public comment will continue to be offered through various media outlets, the cooperative's website, and the physical office of RCEC.