

Section 1: Introduction

During June of 1936, the Missouri Rural Electric Cooperative was formed to meet the electrical needs of customers in northeast Missouri. Palmyra, Missouri serves as the headquarters for the MO Rural Electric Cooperative (MO REC). Service is provided to customers in five counties in northeastern Missouri: Lewis, Marion, Monroe, Ralls and Shelby. A nine member board of directors provides direction for the cooperative. The goal of the MO REC is as follows:

“To improve its members’ standard of living by providing a reliable supply of electricity at the lowest possible cost.”

The MO REC service territory consists of approximately 1,100 miles of energized line which serves customers in a portion of Lewis, Marion, Monroe, Ralls and Shelby 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, MO Rural Electric Cooperative.)

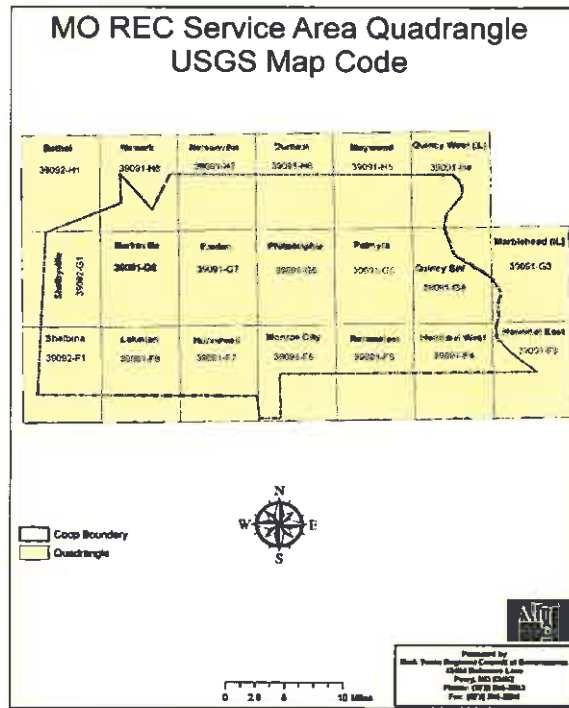
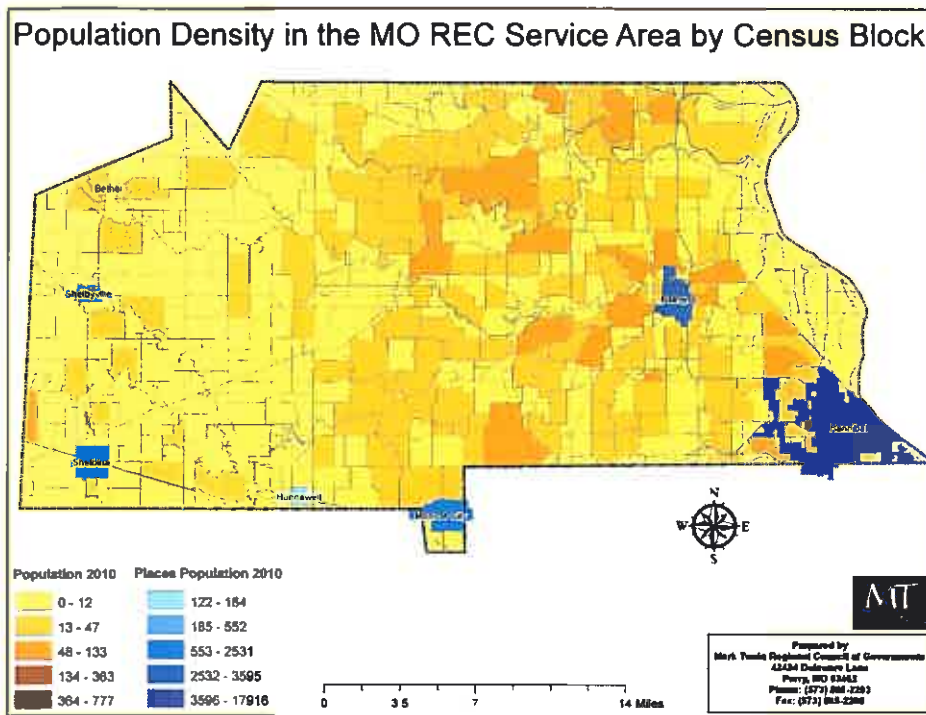


Figure 1

The MO REC currently has more than 7,128 connected meters and 4,075 members in the five county service area. Residential customers account for approximately 90% of memberships (4,639) while non-residential customers make up the remaining 10% (533). Table 1.1 provides the summary of metered customers by county.

Table 1.1		Meters by County
County		Number of meters
Lewis		59
Marion		5817
Monroe		299
Ralls		59
Shelby		894

MO REC’s average daily customer usage is 40 kilowatt-hours (kWh). During 2010, the annual total usage of MO REC customers was 62,755,071kWh of service (residential). 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 MO REC. 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 MO REC office in Palmyra 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.

Meeting Date	Attendees, Title, Organization	Topics of discussion
August 16, 2011	Kyle Crowe, Operations Manager, MO REC Sue Bridgman, Mngr. Finance & Accounting, MO REC Doug Krigbaum, Mngr Member Services, MO REC Robert Pyse, Staking Eng, MO REC Robin Fitzgerald, Director, MTRCOG Cindy Hultz, Fiscal Officer, MTRCOG	MO REC business structure Customer information Critical facilities information Asset inventory by type and location Data collection assignments
September 7, 2011	Richard Donelson, General Manager, MO REC Kyle Crowe, Operations Manager, MO REC Sue Bridgman, Mngr. Finance & Accounting, MO REC Doug Krigbaum, Mngr Member Services, MO REC Robert Pyse, Staking Eng, MO REC Robin Fitzgerald, Director, MTRCOG Cindy Hultz, Fiscal Officer, MTRCOG	Data collection review Current mitigation strategies Establishment of goals, actions, and objectives
September 26, 2011	Kyle Crowe, Operations Manager, MO REC Sue Bridgman, Mngr. Finance & Accounting, MO REC Robert Pyse, Staking Eng, MO REC 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. MO 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:

- Lewis County Commission,
- Marion County Commission,

- Monroe County Commission,
- Ralls County Commission, and the
- Shelby County Commission.

The MO REC provides service to critical facilities that includes a group home, airport, radio station, emergency services, rural fire district, rural water district, a hospital, medical buildings, telecommunications, and schools all of which were invited to participate in the public comment period.

Section 3: Asset inventory

MO Rural 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. Sixteen vehicles provide access to customers and infrastructure. MO REC does not own any electric generation or transmission infrastructure. Approximately 1,100 miles of distribution lines are owned and maintained by MO REC. Table 1.3 provides information concerning total asset valuation.

Table 1.3 MO REC Inventory Valuation Summary		
Asset	Total Replacement Cost	Cost breakdown
Total MO REC Assets	\$17,443,6324	Buildings and vehicles - \$3,741,897 Overhead assets - \$16,799,952 Underground assets - \$643,672
Distribution Lines	\$5,087,443 OH \$230,073 UG	OH Single-phase lines - \$4,033,096 UG Single-phase lines - \$220,496 OH Three-phase lines - \$1,054,347 UG Three-phase lines - \$9,577
Supporting Infrastructure	\$11,678,750 OH \$413,599 UG	OH Meters - \$171,008 UG Meters- \$202,297 Poles - \$3,660,223 OH Transformers - \$5,617,692 UG Transformers - \$211,302 Guys/Anchors - \$731,192 Cross-arms - \$888,720 Regulators - \$225,040 SP Oil-Circuit Reclosures - \$188,928 TP Oil Circuit Reclosures - \$119,500 Capacitors - \$76,447
Office Buildings	\$1,100,000	
Warehouses	\$1,330,500	
Vehicles	\$1,311,397	

Source: Internal MO REC Accounting and Insurance records, 2011

Ensuring quality distribution to its customers, MO Rural 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.

Table 1.4 MO REC Asset Inventory by service county

Asset	Emergency Replacement Cost per unit or mile	Number of units or miles Lewis	Number of units or miles Monroe	Number of units or miles Shelby	Number of units or miles Wayne	Number of units or miles Ralls	Number of units or miles Shelby	Total number of units or miles
Meter	\$320.09/unit	55 OH 4 UG	4,090 OH 560 UG	279 OH 20 UG	29 OH 30 UG	876 OH 18 UG	5,329 OH 632 UG	
Pole	\$166.20/unit	16	16,215	1,738	22	4,032	22,023	
SP*** distribution line	\$4,643/mile OH (\$.88/foot OH) \$4,643/mile UG (\$.88/foot UG)	.90 OH 0 UG	598.67 OH 44.2 UG	82.11 OH 1.32 UG	.96 OH .36 UG	186.81 OH 1.61 UG	869.45 OH 47.49 UG	
TP**** distribution line	\$5,262/mile (\$1.00/foot OH) \$5,262/mile UG (\$1.00/foot UG)	0 OH 0 UG	179.02 OH 1.72 UG	4.90 OH .10 UG	0 OH 0 UG	16.45 OH 0 UG	200.37 OH 1.82 UG	
Transformers	\$774.00 OH \$774.00 UG	3,136 OH 136 UG	146 OH 4 UG	1422 OH 55 UG	1897 OH 71 UG	657 OH 7 UG	7,258 OH 273 UG	
Guys/anchors	\$28.00/unit	11,285	525	5,118	6,824	2,362	26,114	
Cross-arms	\$92 ea	4,175	194	1,893	2,524	874	9,660	
Regulators	\$3,188 ea	34	2	16	21	7	80	
Oil Circuit Reclosures	\$656 SP \$11,950 TP	124 SP	6 SP 10 TP	56 SP	76 SP	26 SP	288 SP 10 TP	
Capacitors	\$469/unit	70	3	32	43	15	163	
Total replacement value by county		3,358,513 OH 106,544 UG	6,824,580 OH 396,618 UG	2,225,669 OH 55,627 UG	2,037,573 OH 66,228 UG	2,353,617 OH 18,655 UG	16,779,952 OH 643,672 UG	

OH = overhead UG = underground ***SP = Single phase ****TP = Three phase

Source: Internal MO REC Accounting and Maintenance records

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 MO Rural 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 MO REC because of asset types and geographic location in the state of Missouri. Those hazards eliminated for the MO REC 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 MO REC 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 MO REC 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 MO REC service region. Wildfires were eliminated due to the very minimal threat.

For the purpose of this risk assessment, the identified hazards for the MO REC 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 MO REC, hazards with historical data include tornadoes, severe thunderstorms/high wind, and severe winter weather.

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 MO REC, hazards without historical data include earthquakes and dam/levee 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 MO REC 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 \$20,541,849
- Overhead infrastructure assets only
 - Used for:
 - Severe Thunderstorm / High Wind / Hail
 - Flood
 - Severe Winter Weather
 - Valued at \$16,799,952

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 MO Rural 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 MO Rural 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				

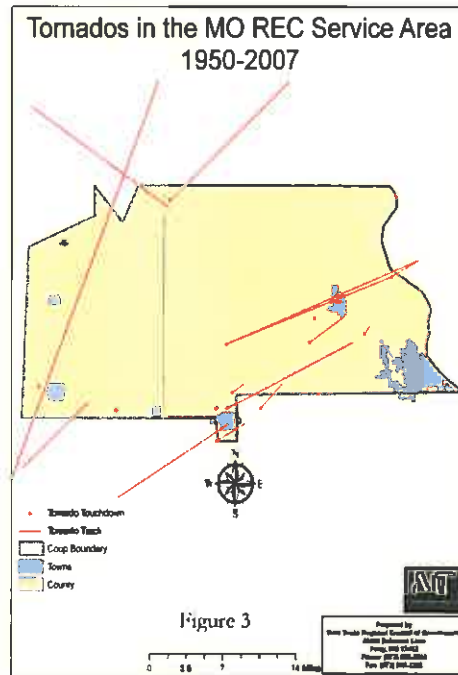
Section 5: Risk Assessment

A) Historical Hazards:

Tornadoes

In the last 57 years, 34 tornadoes have been reported within the MO Rural 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 1996 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 1997-2011, MO REC's service area within the state of Missouri has experienced a total of seventeen tornadic events. Using the previously described methodology, the probability of a tornadic event in the MO REC service area in any given year is near 100% (17 events / 14 years = 121%). Estimated cooperative material damages associated with each of these events were compiled by MO REC staff beginning in 2006. Six of the 17



occurrences caused damage to cooperative assets, resulting in 35% probability that any given tornadic occurrence will produce damage (6 events / 16 occurrences = 35%). Table 1.7 provides a summary of the event date, EF-scale ratings, and outages reported.

Date of event	EF Scale rating	Damage estimates	Outages Reported
3/12/06	F4	\$2,000	41
4/02/06	F2	\$2,000	44
3/01/07	F1	\$28,000	576
8/08/07	F0	\$15,000	350
10/02/07	F2	\$3,600	521
10/17/07	F2	\$2,700	58

Data provided based on internal MO REC records which reflect cost from the referenced event year.

Based upon the last fourteen years of historical event records, the average tornado to affect the cooperative will include an EF0-4 rating, causing an average damage cost of \$8,883.33 per event (\$53,300/6 events = \$8,883.33) This averaged amount accounts for less than 1% of the MO REC’s total overhead assets and building valuation (\$8,883.33 / \$20,541,849 = 0.0004%). Table 1.8 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

MO Rural Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Tornado		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 265 customers reported outages during recorded tornadoes since 1997. When compared with the total number of customers served by MO REC, it can be projected that 5% of all customers may report outages during any given tornadic event. Table 1.9 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

MO Rural Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Tornado		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, MO REC’s service area within the state of Missouri has experienced a total of 88 hail events and 117 thunderstorm/high wind events. Therefore, the probability of a hail event in the MO REC service area in any given year is near 100% (88 events / 15 years = 587%) while the probability of a thunderstorm/high wind event in any given year is also near to 100% (117 events / 15 years = 780%). Estimated material damages associated with each of these events were compiled by MO REC staff with data beginning in 2006. Three of the 88 events caused damage to cooperative assets, resulting in a 3% probability that any given hail occurrence will produce damage. (3/88 = 3.4%)

Based upon historical records, the average hail event to affect the cooperative will cause an average damage cost of \$1,500 (\$4,500 / 3 = \$1,500). This averaged amount accounts for less than 1% of the MO REC’s total overhead asset valuation (\$1,500 / \$16,799,952 = 0.00008%). Table 1.10 provides a summary of those hail events which caused damage to cooperative infrastructure by date, cost estimate of damage and reported outages.

Date of event	Damage estimates	Outages Reported
4/02/06	\$1,500	24
4/19/06	0	1
6/27/06	0	3
6/30/06	0	7
7/31/06	\$1,500	169
10/17/07	\$1,500	42

Table 1.11 provides a summary of those Thunderstorm/High Wind/l events which caused outages to cooperative infrastructure by date, cost estimate of damage and reported outages. Four of the 117 occurrences caused damages to cooperative assets,

resulting in a 3.4% probability that any given thunderstorm/high wind occurrence will produce damage (4 / 117 = 3.4%)

Table 1.11 MO REC Thunderstorm/High Wind Event Summary

Event date	Damage estimates	Outages reported	Event date	Damage estimates	Outages reported
3/12/06	0	89	8/26/06	0	1
3/30/06	\$2,000	509	3/31/07	0	122
4/02/06	0	1	6/07/07	0	120
4/19/06	0	1	8/08/07	0	5
5/31/06	0	3	8/12/07	\$2,000	270
8/02/06	\$1,000	194	8/16/07	\$1,000	104

Data provided based on internal MO REC records which reflect outages from the referenced event year.

Based upon historical records, the average thunderstorm/high wind event to affect the cooperative will cause an average damage cost of \$1,500 (\$6,000 / 4 events = \$1,500). This average amounted to less than 1% of MO REC’s overhead asset valuation \$1,500 / \$16,799,952 = 0.00008%. Table 1.12 demonstrates the probability of occurrence in conjunction with the potential extent of damage for both hail and thunderstorm/high wind events.

Table 1.12

MO Rural 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 93 customers (overall average per incident) reported outages during recorded hail, thunderstorm, and high wind events since 1996. When compared with the total number of customers served by MO REC, it can be projected that 1.3% of all customers may report outages during any given hail, thunderstorm, or high wind event. Table 1.13 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

Table 1.13 MO Rural Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Thunderstorm/High Wind/Hail		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				

Flood and Levee Failure

Flood and levee failure carries very minimal ongoing potential threat to the existing infrastructure of the MO Rural Electric Cooperative. Approximately 12% of the cooperative service area is located directly within the 100 year floodplain. The remaining service area is not located 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, MO REC’s service area has experienced 18 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 near 100% (18 events / 15 years = 120%). Estimated material damages associated with each of these events were compiled by MO REC staff. Table 1.14 summarizes flood events by month, damage cost estimate, and reported outages. One of the 18 flooding occurrences caused damages to cooperative assets resulting in a 5.6% probability that any given flood event will produce damage (1/18=5.6%)

Event date	Damage estimates	Outages reported
8/25/07	\$8,000	27

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. Based upon historical records, the average flood/levee failure event to

affect the cooperative will cause an average damage cost of \$8,000 (\$8,000/1 event = \$8,000). This averaged amount accounts for less than 1% of the MO REC’s overhead asset valuation. ($\$8,000 / \$16,799,952 = 0.0005\%$). Table 1.15 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Table 1.15 MO Rural Electric Cooperative Infrastructure 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	≥ 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 27 customers reported outages during recorded flooding events since 1996. When compared to with the total number of customers served by MO REC, it can be projected that less than 1% of all customers may report outages during any given flooding event. Table 1.16 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

Table 1.16 MO Rural 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				

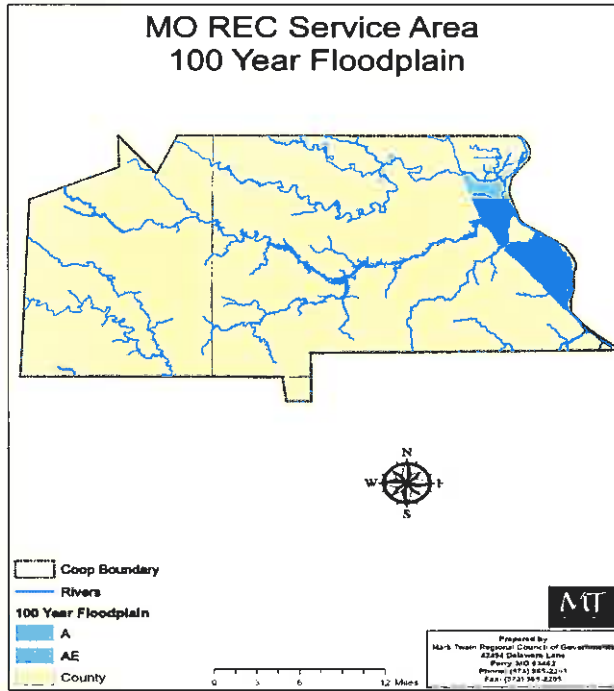


Figure 4

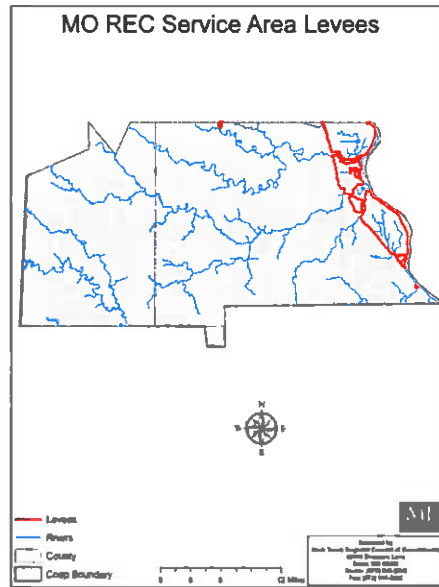


Figure 5

Severe Winter Weather

From 1996-2011, MO REC’s service area has experienced a total of 39 severe winter weather events, including significant snowfall and ice storms. Therefore, the probability of a severe winter weather event in the MO REC’s service area in any given year is near 100% (39 events / 15 years = 260%). Estimated material damages associated with each of these events were compiled by MO REC staff, but damage estimates are available from 2006-2011 only. Table 1.17 provides a summary of event dates, types, associated damage estimates, and reported outages. Four of the 39 occurrences caused damage to cooperative assets, resulting in a 10.3% probability that any given severe winter weather occurrence will produce damage (4/39 = 10.26%)

Event date	Event type	Damage estimates	Outages reported
12/01/06	Winter Storm	\$2,400	212
1/12/07	Ice Storm	\$5,000	864
12/06/07	Winter Weather	\$2,900	54
12/08/07	Ice Storm	\$2,400	50

Data provided based on internal MO REC records which reflect cost from the referenced event year.

Based upon these historical records, the average severe winter weather event to affect the cooperative will cause an average damage cost of \$3,175 (\$12,700/4 = \$3,175). This averaged amount accounts for less than 1% of the MO REC’s total overhead asset valuation (\$3,175/\$16,799,952 = 0.0002%). Table 1.18 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

MO Rural 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 295 customers reported outages during recorded severe winter weather events since 1996. When compared with the total number of customers served by MO REC, it can be projected that 4.3% of all customers may report outages during any given

severe winter weather event. Table 1.19 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

MO Rural Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Severe Winter Weather		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 MO REC service area presents a unique risk assessment. Wildfire events have occurred in each of the five counties. According to the Missouri Department of Conservation, Lewis, Marion, Monroe, Ralls and Shelby have experienced wildfires between 2004 and 2008. Table 1.20 summarizes the incidences of wildfire within the five counties. Therefore, the probability of a wildfire event in the MO REC service area in any given year is near 100% (219 / 4 years = 5,475%). However, for the purposes of this assessment, wildfire and its associated impacts cannot be eliminated from the realm of possibility.

County	# of Wildfires, 2004-08	Average Annual # of Wildfires	Likelihood (1-5)	Acres Burned	Average Annual Acres Burned	Total Buildings Damaged	Vulnerability
Lewis	50	10	1	311	62	5	Low
Marion	55	11	1	579.45	116	0	Medium-Low
Monroe	53	10.6	1	1,012.5	203	0	Medium-Low
Ralls	29	5.8	1	285	57	0	Low
Shelby	32	6.4	1	395.7	79	0	Low
Totals	219	43.8	1	2,583.65	517	5	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 MO REC service area. To date, 219 fires have burned a total of 2,583.65 acres for an average of

11.8 acres affected per event. MO REC 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 11 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 1.21). Further study will be required to create a model for damage assessments related to wildfire.

Table 1.21 MO Rural 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 MO REC, it can be projected that 0% of all customers may report outages during any given wildfire event. Table 1.22 demonstrates the probability of occurrence with the potential extent of impact upon local customers.

Table 1.22 MO Rural 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 MO REC 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 MO REC 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, Lewis) would experience a Level VII intensity, while the remaining two counties (Monroe and Shelby) would experience a Level VI intensity characteristics.

In the event of an earthquake with a 7.6 rating, Monroe and Shelby Counties would experience a Level VII intensity, while Ralls, Marion and Lewis Counties would experience intensities of VIII. Subsequently, an earthquake of 8.6 magnitude would result in Monroe and Shelby Counties experiencing intensities of VIII. Consequently, intensity levels in Ralls, Marion and Lewis 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 MO REC 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 1.23.

Table 1.23 MO Rural Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Earthquake		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 517 customers could report outages related to a substantial earthquake event. When compared with the total number of customers served by MO REC, it can be projected that 10% of all customers may report outages during any given seismic event. Table 1.24 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.24 MO Rural 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 MO REC service area to date. According to Missouri DNR’s Dam Safety Division, 63 dams currently exist within the cooperative boundaries: 49 in Marion County, 13 in Shelby County, and one in Monroe County. Of these dams, only one dam is regulated which is located in Shelby County as it is considered a non-agricultural dam and exceeds 35 feet in height. Figure 6 shows the locations of all known dams located within MO REC’s service area. (Map source: *www.msdis.missouri.edu*;)

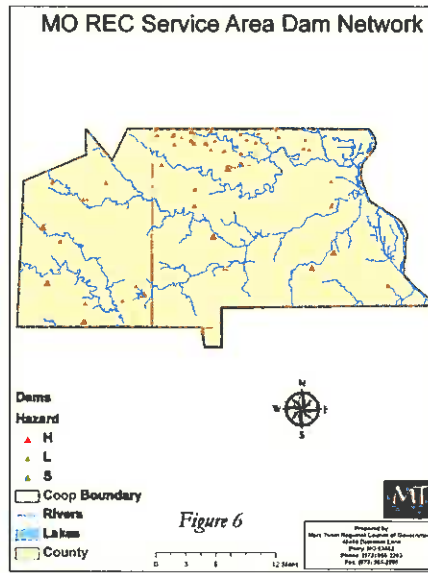


Figure 6

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%.

MO Rural Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Dam Failure		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 1.25 and 1.26)

Table 1.25 MO Rural Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Dam Failure		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 MO REC, 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 build, 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. MO Rural 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 MO REC 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, MO REC 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 MO REC 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 1.27 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.

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 MO REC.
- **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 1.28, 1.29, and 1.30 provide a list of action items by tier as well as the goals and objectives identified with each.

Table 1.28 Prioritized Mitigation Actions for MO Rural Electric Cooperative – Tier 1

Tier 1			
<i>Action item:</i>	<i>Goal/Objective</i>	<i>Timeframe for completion</i>	<i>Cost-benefit score</i>
Complete annual inspections of lines and poles.	Goal 1 / Objective 1 Goal 2 / Objective 1	Completed annually.	Low cost High Benefit Score: 9
Perform routine maintenance and utilize upgraded equipment where possible to ensure quality of system. Tasks may include part replacement and/or upgrades. Identified work includes, but is not limited to: <ul style="list-style-type: none"> • Addition of lightning arresters, electronic reclosures, conductors, guidewires. • Replacement or repair on poles, cross-arms, lines. • Raising transformers with pad mounts. 	Goal 1 / Objective 1 Goal 2 / Objective 1	Ongoing effort	Low cost High benefit Score: 9
Use vegetation management to prevent interference with delivery of power.	Goal 1 / Objective 1 Goal 2 / Objective 1	Ongoing effort	Low cost High benefit Score: 9
Convert OII lines to UG or vice versa in areas of vulnerability Add alternate source wiring to reduce outage time Install taller poles in flood plain	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 1 Goal 2 / Objective 2	Ongoing effort; Completed as funding allows.	Medium cost High benefit Score: 8
Upgrade to steel or concrete poles	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 1 Goal 2 / Objective 2	Ongoing effort; Dependent upon funding.	High cost High benefit Score: 7
Add Fault Finder (Thumper) Equipment	Goal 1 / Objective 2	Dependent upon funding	Low cost Low Benefit Score: 3

Table 1.29 Prioritized Mitigation Actions for MO Rural Electric Cooperative – Tier 2

Tier 2			
<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
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 High benefit Score: 9
Set up Command Control Office Area	Goal 1/ Objective 1 Goal 1/ Objective 2 Goal 3/ Objective 1 Goal 3/ Objective 2	Dependent upon available funding	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: 5

Table 1.30 Prioritized Mitigation Actions for MO Rural Electric Cooperative – Tier 3

Tier 3			
<i>Action item:</i>	<i>Goal/Objective</i>	<i>Timeframe for completion</i>	<i>Cost-benefit</i>
GPS all infrastructure	Goal 2 / Objective 2 Goal 3 / Objective 1	Dependent upon additional funding	High cost High benefit Score: 7
Improve outage management using GIS system.	Goal 2 / Objective 1 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	Medium cost Medium benefit Score: 5
Install laptops in mobile units	Goal 1 / Objective 2 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	Medium cost Medium benefit Score: 5
Install SCADA system	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 1 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	High cost Medium benefit Score: 4
Install vehicle locating electronics	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 2	Dependent upon additional funding.	Medium cost Low benefit Score: 3
Monitor developments in data availability concerning the impact of dam failure and wildfire upon the MO REC 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 MO REC employment level as the organization strives to ensure quality service to their customers.

Other Local Planning Mechanisms

Beyond the MO REC plan, few planning mechanisms exist at the local level. The Missouri counties of Lewis, Marion, Monroe, Ralls and Shelby 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). MO REC's plan can be easily incorporated into these local plans and allow for coordination across agencies in the event of an emergency.

MO REC 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.

Plan Maintenance

MO REC 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

MO REC 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 MO REC.