Contents: Gascosage Electric

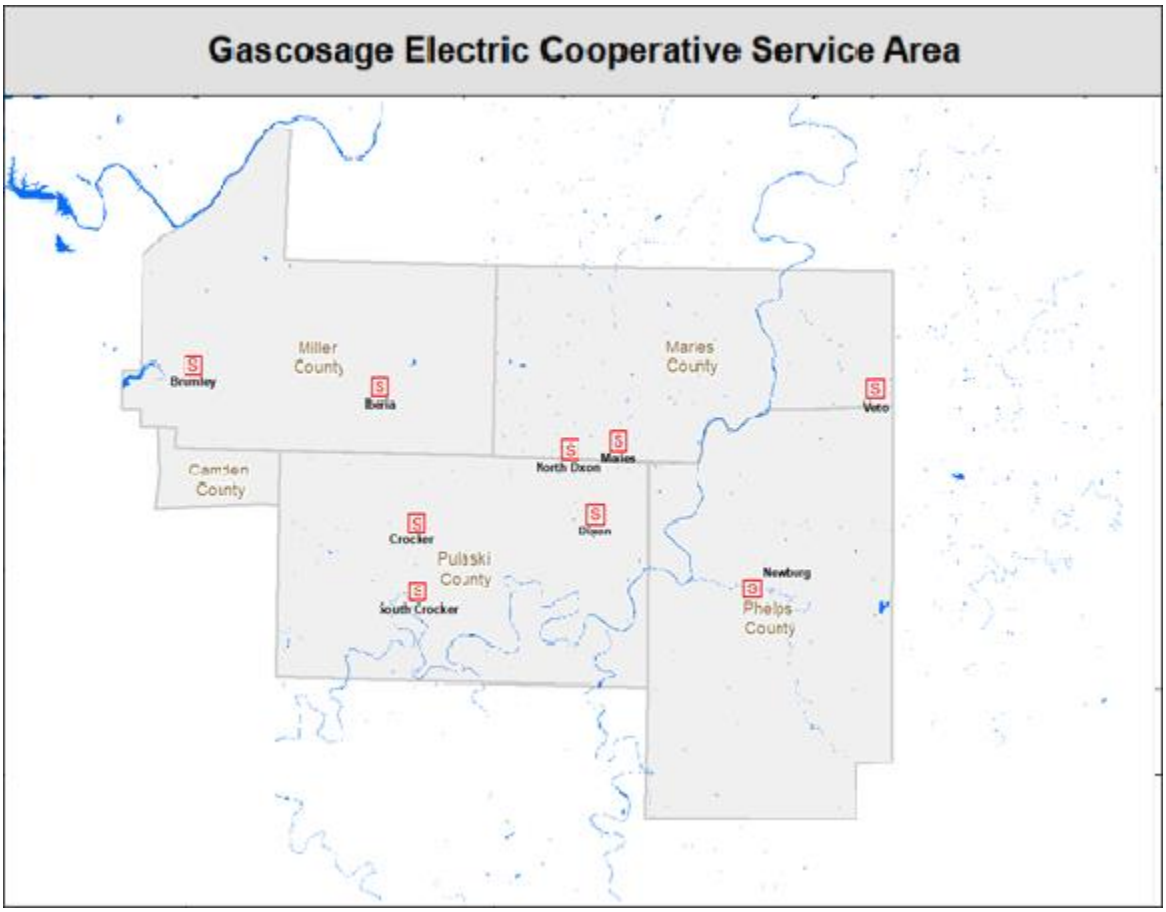
Section 1: Introduction

Gascosage Electric Cooperative (Gascosage or GEC) was established in 1938 to provide electric service to the rural areas of South Central Missouri. Gascosage is headquartered in Dixon, Missouri, and provides service to members in portions of Maries, Miller, Phelps, Pulaski and Camden counties in Missouri. The cooperative owns 1,584 miles of service line within these counties as of December 2021. The cooperative is run by a board of nine directors which approve the company's mission and internally developed business policy:

> *"Gascosage Electric Cooperative provides our diverse membership an unsurpassed level of comprehensive service using the latest proven technological advances in the electrical industry to deliver reliable and affordable electricity in the traditional style of personalized service."*

Figure 1 depicts the service area boundaries of the cooperative.

Figure 1 *Gascosage Electric Cooperative Service Area*



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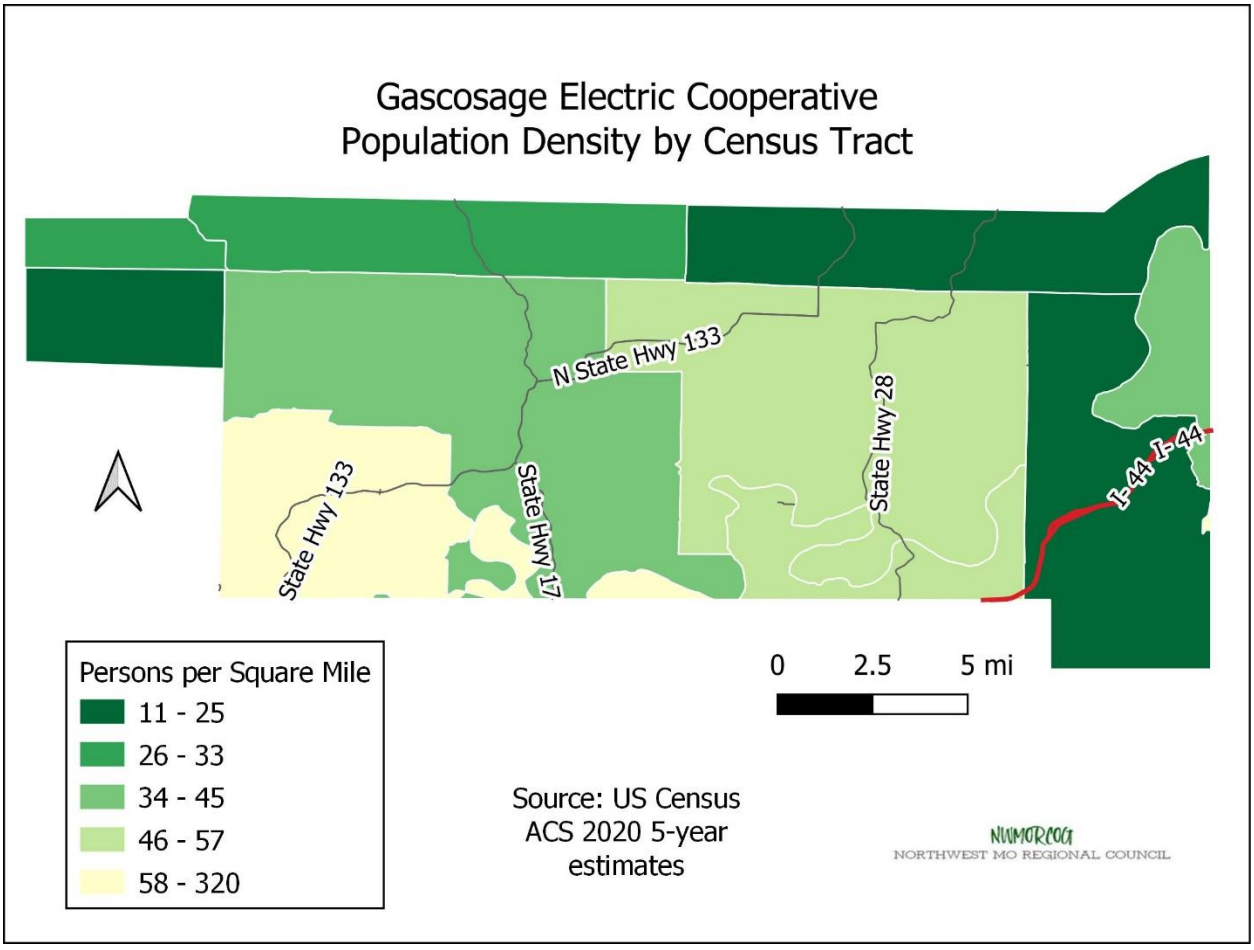
The customer base of Gascosage is 9,871 members. Residential customers account for 91 percent of memberships (8,983 meters) while non-residential customers make up the remaining 9 percent (888 meters).

Table 1 *Meters by Missouri County*

County	Number of Meters
Camden	9
Maries	1112
Miller	3041
Phelps	1344
Pulaski	4365
Total	9,871

The average daily customer usage for Gascosage is 55 kilowatt-hours (kWh). Annual total usage of Gascosage customers in 2016 was 200,681513 kWh of service. Population density for the cooperative service area is depicted in Figure 2 (*Map source: U.S. Census 2020*).

Figure 2 *Population Density by Census Block in the Gascosage Electric Cooperative*



Critical Facilities

It is important in mitigation planning for the electric cooperatives to identify the critical facilities in each area and to be able to prioritize reconnection and back-up power needs. Gascosage provides service to two nursing homes, one ambulance district in Dixon and fire stations in Dixon, Crocker, Swedeborg and Iberia. Gascosage does not provide service to any higher education institutions, or large industrial centers.

Future Development

Gascosage has a member showing interest in a bitcoin mining facility that will increase our kWh usage by a third. Table 2 below illustrates the population trend for the counties served by Gascosage.

Table 2 *County Population Trend, 1990-2030*

County	1990	2000	2010	2020	2030 Projected
Camden	27,495	37,051	44,002	46,414	49,124
Maries	7,976	8,903	9,176	8,795	10,406
Miller	20,700	23,564	24,748	25,791	28,404
Phelps	35,248	39,825	45,156	44,414	47,635
Pulaski	41,307	41,165	52,274	52,709	46,520
	Source: U.S. Census Data				

Planning Process

Since the planning process is the same for each of the electric cooperative plans, the details of the planning process are presented in the Statewide Summary section of the plan.

Appendices

Three appendices are included at the end of each plan:

Appendix A contains the Adoption Resolution; a document signed by the Cooperative's governing official showing that the Board of Directors has adopted the mitigation plan.

Appendix B contains the Documentation of Participation; copies of press releases, website postings and other public outreach that was made to request public comment.

Appendix C contains the Surveys; the Data Survey that is the source of data for the 2023 plan update; the Goals and Actions Survey is the updated review of the mitigation strategies.

Section 2: Asset Inventory

Gascosage Electric Cooperative has a wide variety of assets by type. Real estate owned by the company includes office buildings, garages, and other outbuildings located in Dixon. Thirty-Three vehicles provide access to customers and infrastructure. Gascosage does not own any electric generation or transmission infrastructure; 1,584 miles of distribution lines are owned and maintained by Gascosage. Table 3 provides information concerning total asset valuation.

Table 3 *Gascosage Asset Inventory Valuation Summary*

Asset	Total Replacement Cost	Cost Breakdown
Total Gascosage Assets	$149,872,464	Buildings and contents – $8,284,104 Vehicles and trailers - $2,158,139 Power Operated Equipment - $2,285,609 Communications Equipment - $104,552 Overhead assets - $41,820,020 Underground assets - $185,856
Distribution Lines	$41,820,020 OH $185,856 UG	OH Single-phase lines - $25,787,520 UG Single-phase lines - $176,055 OH Three-phase lines - $16,032,500 UG Three-phase lines - $9,801
Supporting Infrastructure	$95,034,184 OH	Meters - $2,990,913 Poles - $55,764,060 Transformers - $16,643,792 Guys - $3,311,078 Anchors - $13,831,675 Cross-arms - $1,233,716 Reclosers - $998,250 Regulators - $161,700 Capacitors - $99,000
Office Buildings and contents	$8,284,104	
Vehicles	$2,158,139	
Source: Distribution – Engineers/GIS System, Other Assets-Accounting/GL Records		

Ensuring quality distribution to its customers, Gascosage maintains not only distribution lines, but also the supporting infrastructure as well. Table 4 includes a list of asset types, emergency replacement cost per unit or mile, the asset inventory by Service County, and total infrastructure numbers.

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Table 4 *GEC Asset Inventory by Service County*

County	Emergency Replacement Cost per unit or mile	Number of units or miles: CAMDEN	Number of units or miles: MARIES	Number of units or miles: MILLER	Number of units or miles: PHELPS	Number of units or miles: PULASKI	Number of units or miles: TOTAL
Meters	$303/unit	9	1,112	3,041	1,344	4,365	9,871
Poles	$1,815/unit	83	4,850	10,027	4,434	11,330	30,724
SP*** Distribution Line	$19,360/mile OH $90,750/mile UG	6 OH** 0 UG	236 OH 0.5 UG***	426 OH 0.29 UG	211 OH 0.85 UG	453 OH 0.3 UG	1,332 OH 1.94 UG
TP**** Distribution Line	$64,130/mile OH $163,350/mile UG	0 OH 0 UG	31 OH 0 UG	73 OH 0.06 UG	37 OH 0 UG	109 OH 0 UG	250 OH 0.06 UG
Transformers	$1,936/each OH	24 OH	1,062 OH	2,926 OH	1,152 OH	3,433 OH	8,597 OH
Guys/ anchors	$149/unit $715/unit	53 53	2,947 2,724	8,083 6,772	3,428 2,957	7,711 6,839	22,222 19,345
Cross-arms	$242/ each	0	561	1,666	654	2,217	5,098
Regulators	$5,390/each	0	6	10	5	9	30
Reclosers	$3,630/each	0	48	87	38	102	275
Capacitors	$3,300/unit	0	6	10	5	9	35
Total Replacement Value by County		$361,788 OH $0 UG	$20,501,613 OH $45,375 UG	$44,566,243 OH $36,119 UG	$20,107,669 OH $77,138 UG	$51,316,890 OH $27,225 UG	$136,854,203 OH $185,857 UG

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

Source: Internal Gascosage Accounting and Maintenance records

Section 3: Risk Assessment

Risk Assessment Methodology

The risk assessment methodology used in the following section was utilized for both the statewide aggregation as well as for each individual cooperative chapter. Section 4 of the Statewide Summary details this methodology. Some variation in the availability of data exists between the electric cooperatives as each utilizes a different system of recording the impact of natural disasters. Any differentiation from the process below is explained in the individual cooperative's chapter as necessary.

For the purpose of this risk assessment, the identified hazards for the Gascosage service area have been divided into two categories: **historical and non-historical hazards.** Based on the data collected for the update, the hazards have been reclassified to reflect the actual data available and those hazards with no data available have been reclassified as non-historical. This does not mean that a non-historical hazard will never cause damage, it just means to date, there has been no impact. The potential still exists, but the probability of the occurrence is numerically close to zero. For the analysis in this plan non-historical hazard probability is stated as less than one.

> **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 Gascosage, hazards with historical data include tornadoes, severe thunderstorms/high wind/hail, flood/levee failure 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 Gascosage, hazards without historical data include wildfire, earthquakes, dam failure and land subsidence.

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 $145,138,307

- Overhead infrastructure assets only
    - Used for:
        - Severe Thunderstorm / High Wind / Hail
        - Flood
        - Severe Winter Weather
            - Valued at $136,854,203

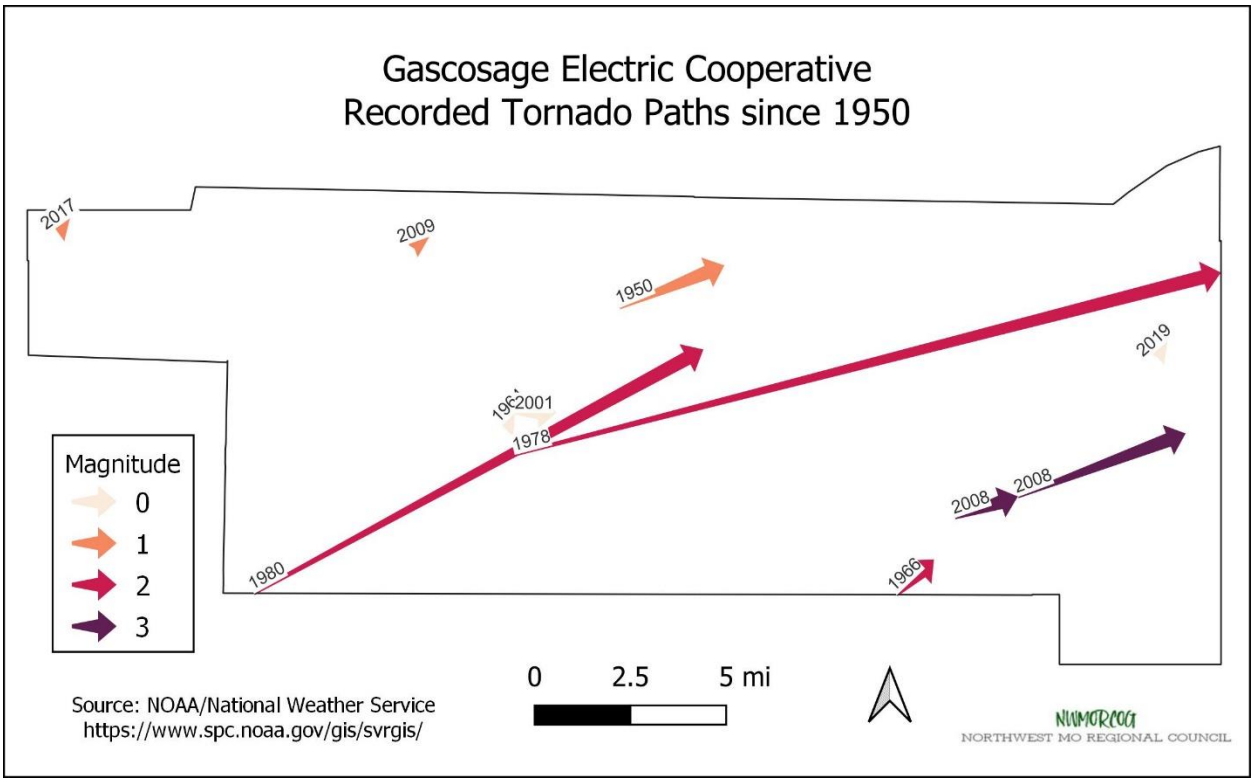
A. Historical Hazards

Tornadoes

Previous Occurrences

From 1950-2020, 11 tornadoes have been reported within the Gascosage cooperative boundaries. Figure 3 provides a pictorial representation of all recorded tornado touchdown sites and recorded paths. *(Data for map collected from NOAA.)*

Figure 3 *Tornado Impacts in the Gascosage Electric Cooperative*



Probability of Future Occurrence and Vulnerability

A data insufficiency exists, however, 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. Gascosage was able to provide data for those events that resulted in FEMA claims.

From 2007-2016, GEC's service area within the state of Missouri has experienced a total of three tornadic events. The probability of a tornadic event in the Gascosage service area in any given year is 30 percent. Estimated cooperative material damages associated with each of these events were compiled by Gascosage staff. Two of the occurrences caused damage to cooperative assets, resulting in a 13.3% chance that a tornado will damage assets in any given year. Table 5 provides a summary of event dates, EF-scale ratings, damage cost estimates and outages reported.

Table 5 *Gascosage Tornadic Event Summary*

Date of Event	EF Scale Rating	Damage Estimates	Outages Reported
1/7/08 (Maries Co.)	F3	$10,055	750
1/7/08 (Phelps Co.)	F3	$28,231	125
	Totals	$38,286	875
Data provided based on internal Gascosage Electric records which reflect cost from the referenced event year.			

Based upon the fifteen years of historical event records, tornado events will cause an average annual damage of $2,553. This averaged amount accounts for less than 0.01% of Gascosage's total overhead assets and building valuation of $136,854,203.

An average annual of 58 outages were recorded during tornadoes since 2007. When compared with the total number of meters served by Gascosage, it can be projected that less than 0.01% of all meters may experience outages during any given year due to a tornadic event.

Problem Statement

GEC has been fortunate to have such a low number of tornadoes touch down in their service area when numerous more storms have hit the surrounding areas outside of their boundaries. GEC should continue to strengthen their infrastructure using manufactured poles and underground placement of lines.

Severe Thunderstorms, High Wind, and Hail

Previous Occurrences

From 1955-2016, Gascosage's service area within the state of Missouri has experienced a total 55 hail events with hailstones of 0.75 inches or larger. During the same period, there were 37 high wind events of 50 knots or higher (approximately 58 mph).

For this update, it was possible to look at the bounds of the Gascosage Electric Cooperative using GPS, finding 91 hail events and 67 high wind/thunderstorm events from 1955-2020.

Probability of Future Occurrence and Vulnerability

The probability of a hail event in the Gascosage service area in any given year is 100% while the average annual event is 1.4. The probability of a thunderstorm/high wind event in any given year is 100%, while the average annual event is 1. Estimated material damages associated with these events were reported as no damage occurred by Gascosage staff.

There have been no hail events that caused damage to Gascosage infrastructure, resulting in a less than 1 percent probability that any given hail occurrence will produce damage. Based upon historical records, the average hail event to affect the cooperative will cause an average annual damage of $0. This averaged amount accounts for less than 1% of Gascosage's total overhead asset valuation of $136,854,203.

Based upon historical records, the average thunderstorm/high wind event to affect the cooperative will cause an average annual damage of $0. This averaged amount accounts for less than 1% of Gascosage's overhead asset valuation.

An average annual of zero customers reported outages during recorded hail, thunderstorm, and high wind events since 1996. When compared with the total number of customers served by Gascosage, it can be projected that less than 1 percent of all customers may report outages during any given hail, thunderstorm, or high wind event.

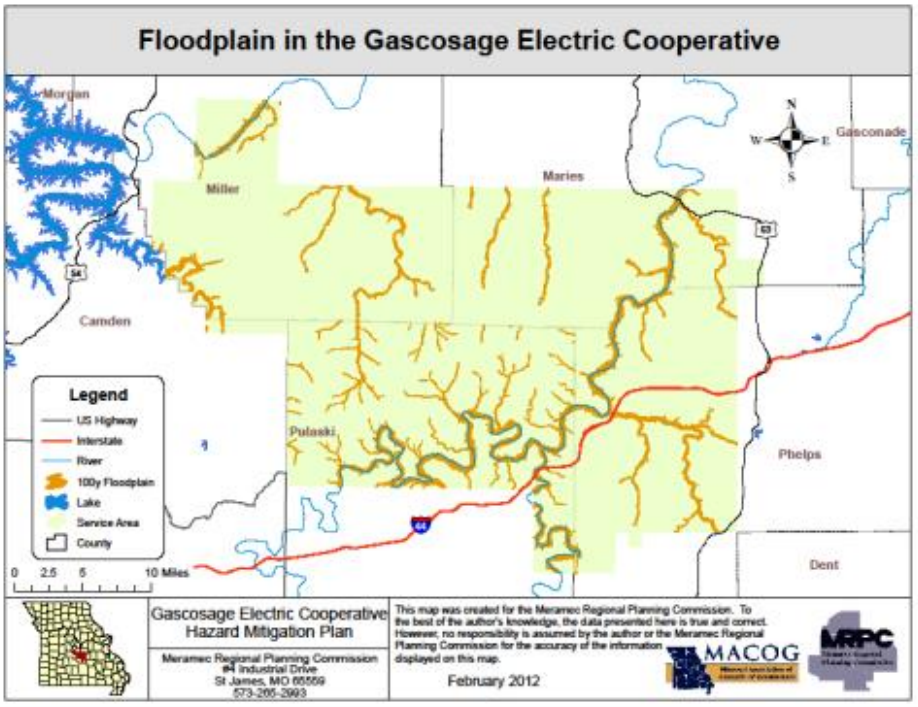
Problem Statement

Although there is strong chance of a potentially damaging hail or wind thunderstorm in any given year, no damages have been recorded by GEC for this hazard. Continued monitoring of infrastructure to maintain uninterrupted service to its customers is recommended.

Flood and Levee Failure

Flooding is a potential threat to the existing infrastructure of the Gascosage Electric Cooperative. The Gasconade River winds through much of the Gascosage's service area in Pulaski, Phelps and Maries counties. Figure 4 below depicts the 100-year floodplain in relation to the cooperative's boundaries. *(Map sources: FEMA HAZUS-MH; DFIRMS; Missouri Office of Administration, and Association of Missouri Electric Cooperatives.)*

Figure 4 *Floodplain in in Gascosage Electric Cooperative*



Previous Occurrences

From 2007 through June 2017, Gascosage's service area has experienced 60 days flooding events. The most recent event occurred at the end of April 2017 when multiple rounds of severe thunderstorms and extremely heavy rainfall, over many days, led to devastating flash floods and record breaking river levels.

For this update, it was possible to look at the bounds of the Gascosage Electric Cooperative using GPS, finding 14 flood events from 2017-2021.

Probability of Future Occurrence and Vulnerability

The average annual number of a flood events occurring within the cooperative service area in any given year is 2.8. Estimated material damages associated with each of these events were compiled by Gascosage staff. Table 6 summarizes flood event dates by month, damage cost estimates, and reported outages. Four months out of the 15-year period damage occurred to cooperative assets, resulting in a 27% probability that a flood occurrence causing damage will occur in any given year.

Table 6 *Gascosage Flood/Levee Failure Event Summary*

Date	County	Damage Estimates	Outages Reported
March 2008	Maries	$1,107	11
	Phelps	$15,604	33
	Pulaski	$12,374	14
August 2013	Maries	$16,064	56
	Phelps	$26,472	16
	Pulaski	$12,147	7
	Miller	$17,261	28
December 2015	Phelps	$34,059	41
	Pulaski	$15,502	39
April 2017	Maries	$30,364	57
	Miller	$2,929	62
	Phelps	$63,065	65
	Pulaski	$62,959	62
	Totals	$309,907	491
Data provided based on internal Gascosage records which reflect cost from the referenced event year.			

Flood events vary widely based upon numerous factors including, but not limited to, annual precipitation. Not all events, however, are extensive as evidenced in Table 6. Based upon historical records, flood events will cause an average annual damage of $20,600. This averaged amount accounts for 0.02% of Gascosage's overhead asset valuation of $145,138,307.

An average annual of 32.7 outages were recorded during flooding events since 2007. When compared with the total number of meters (9,871) served by Gascosage, it can be projected that less than 0.01% percent of all meters may report outages during any given year due to a flooding event.

Problem Statement

With numerous flood-prone rivers crossing its area, GEC needs to waterproof assets when possible.

Severe Winter Weather

Previous Occurrences

From 2007-2021, Gascosage's service area has experienced a total of 15 severe winter-weather events, including blizzards and ice storms. GEC suffered from the ice storm of 2007, experiencing up to one and a half inches of ice accumulation.

Probability of Future Occurrence and Vulnerability

The probability of a severe winter weather event in the Gascosage service area in any given year is 100% with an average annual of 1 events. Estimated material damages associated with each of these events were compiled by Gascosage staff. Table 7 provides a summary of event dates, types, associated damage estimates, and reported outages. One of the 15 occurrences, an ice storm on January 12, 2007, caused damage to cooperative assets, resulting in a seven percent probability that any given severe winter weather occurrence will produce damage and a 0.6% probability that severe winter-weather will result in damage to GEC in any given year.

Table 7 *Gascosage Severe Winter Weather Event Summary*

Event Date	Event Type	Damage Estimates	Outages Reported
1/12/07	Ice Storm	$2,452,737	6,905
Data provided based on internal Gascosage records which reflect cost from the referenced event year.			

Based upon these historical records, severe winter weather events will cause an average annual damage of $163,516. This averaged amount accounts for less than 0.01% of Gascosage's total overhead asset valuation of $136,854,203.

An average annual of 460 outages were recorded during severe winter weather events since 2007. When compared with the total number of meters served by Gascosage, it can be projected that 5% of all meters may report outages during any given year due to a severe winter weather event.

Problem Statement

Underground placement of assets remains the best protection against damage from ice storms.

B. Non-historical Hazards

Wildfire

Previous Occurrences

The incidence of wildfire in the Gascosage service area presents a unique risk assessment. Wildfire events have occurred in each of the five counties. For this hazard Camden County was not included as less than 1% of GEC assets are located within the county. The total area of the rest of the counties is included in the table as wildfire data within the GEC boundaries was not available. Table 8 summarizes the incidences of wildfire within the four counties.

Table 8 *Wildfire Summary by County*

County	# of Wildfires, 2004-16	Average Annual # of Wildfires	Acres Burned	Average Annual Acres Burned
Maries	231	18	4,290	330
Miller	707	54	5,500	423
Phelps	362	28	3,519	271
Pulaski	463	36	3,513	270
Totals	1,401	34	16,822	323
Source: Missouri State Hazard Mitigation Plan, 2018				

Probability of Future Occurrence and Vulnerability

The probability of a wildfire event in the Gascosage service area in any given year is 100% with an average annual of 34 wildfires throughout the four-county area. Although Gascosage does not have records of any significant damage from wildfires, for the purposes of this assessment, wildfire and its associated impacts cannot be eliminated from the realm of possibility.

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 Gascosage service area. With an average annual of 323 acres burned in the area, and a total four-county area of 1,576,960 acres, it is unlikely that infrastructure damage would exceed one percent based upon asset location and the unlikeliness of an uncontrollable wildfire.

No customers have reported outages during recorded wildfires. When compared with the total number of customers served by Gascosage, it can be projected that less than 1 percent of all customers may report outages during any given wildfire event.

Problem Statement

Further study will be required to create a model for damage assessments related to wildfire.

Earthquakes

The closest source of earthquake risk in the Gascosage service area is the New Madrid Fault, which runs from Northern Arkansas through Southeast Missouri and Western Tennessee and Kentucky to the Illinois side of the Ohio River Valley. The other major earthquake fault in Missouri is the Nemaha Uplift which affects the northwest and western side of the state. Most of Missouri's earthquake activity has been concentrated in the southeast corner of the state, which lies within the New Madrid seismic zone.

Previous Occurrences

Although not felt in the GEC service area, the closest and most recent events were a pair of earthquakes that occurred on October 16, 2015. These events were centered near Doniphan, Missouri, which is 118 miles from the GEC service area. The magnitude ratings of these two earthquakes were 3.2 and 3.4.

Probability of Future Occurrence and Vulnerability

The New Madrid fault has the potential to cause damage throughout the state of Missouri, including the GEC 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 projected earthquake intensity ratings for the cooperative region changes based upon the Modified Mercalli Scale. Given a New Madrid earthquake with a 6.7 magnitude, the region would experience Level V intensity characteristics. In the event of an earthquake with a 7.6 magnitude, the region would experience Level VI intensity characteristic while an earthquake with an 8.6 magnitude would most likely cause Level VII intensity characteristics. In the event of an earthquake with a 7.6 rating, the CEC service area would most likely experience minor building damage as well as damage to the electrical distribution system.

This damage would most likely be significantly less when compared with the southeast corner of the state where the fault is located. Distribution lines overhead and underground could become disconnected or severed, and transformers could be damaged. Though the probability of occurrence is very small, the potential extent of damage could significantly impact both the cooperative and its customers.

Based upon information from CERI, FEMA, and SEMA and using the standardized scale for Missouri REC’s, it may be estimated that up to 10%, or 987 customers, could report outages related to an earthquake event of 7.6 magnitude.

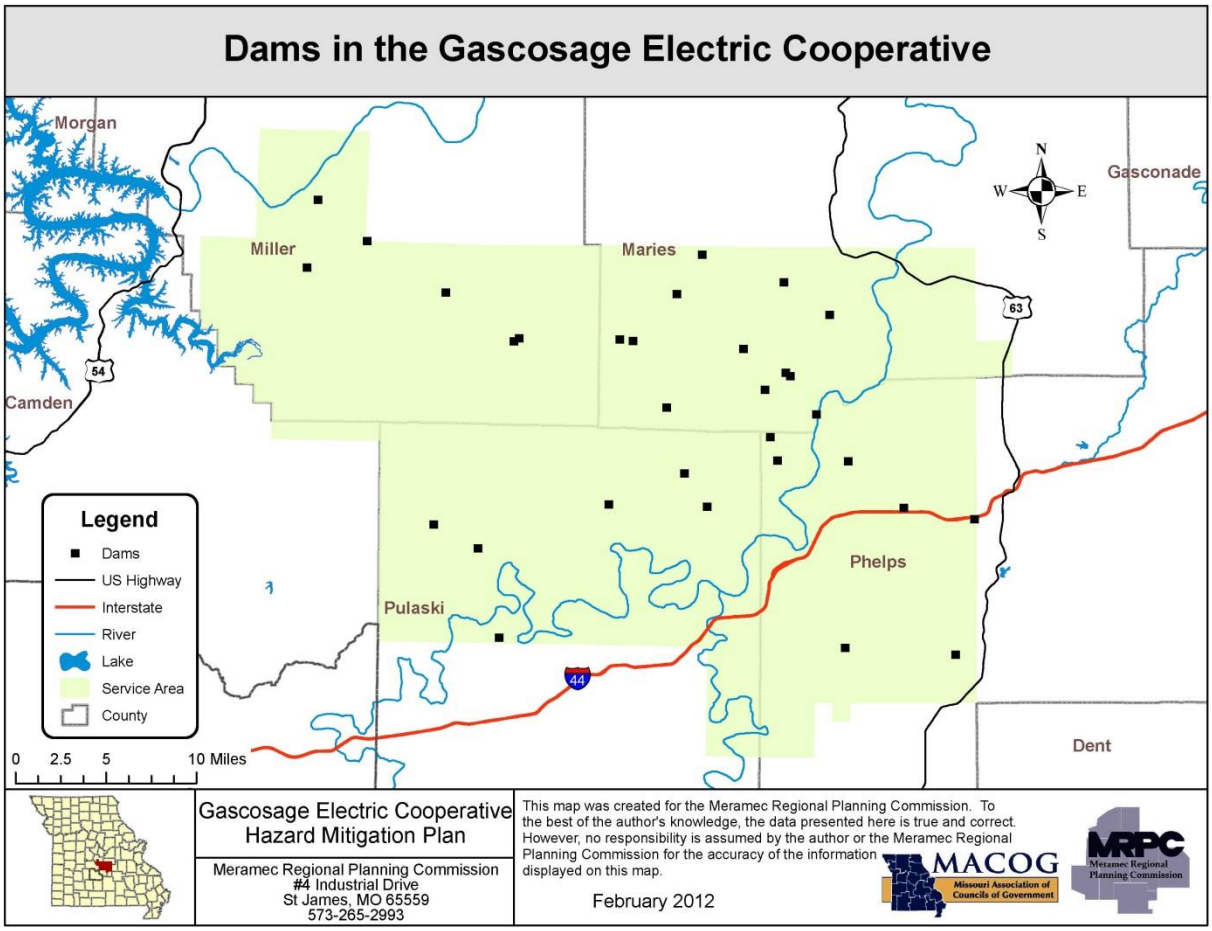
Problem Statement

GEC should strive to meet seismic design standards for electrical substation equipment and other overhead assets susceptible to damage from earthquake events.

Dam Failure

Like earthquakes, dam failures have had no measurable impact upon the Gascosage service area to date. According to Missouri DNR's Dam Safety Division, 110 dams currently exist within the cooperative boundaries: 21 in Camden County, 30 in Maries County, 15 in Miller County, 29 in Phelps County, and 15 in Pulaski County. Of these dams, 11 in Camden County, three in Maries County, two in Miller County, three in Phelps County, and one in Pulaski 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 5 shows the locations of all known dams located within Gascosage's service area. *(Map sources: www.msdis.missouri.edu; www.dnr.mo.gov/env/wrc.)*

Figure 5 *Dams in the Gascosage Electric Cooperative*



Previous Occurrences

The 2018 Missouri State Hazard Mitigation plan states "For the 42-year period from 1975 to 2016 for which dam failure statistics are available, 19 dam failures and 68 incidents are recorded. According to this data, annual probability calculates to a 45 percent annual probability of a dam failure somewhere in the state and a 100 percent annual probability of dam incidents. In should be noted that historical dam failures and incidents include events from all hazard classes and all dams (whether regulated or un-regulated).

Failures and incidents for regulated dams that have higher inspection frequencies should be less probable. The probability of future events is 45%." However, no such event has occurred within or near the cooperative's boundaries.

Probability of Future Occurrence and Vulnerability

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%.

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. Based on discussions with Gascosage staff on location of infrastructure relative to dams, this assessment assumes a limited impact upon downstream electric distribution infrastructure of less than 10% for both infrastructure damage and service interruption.

Problem Statement

Further study concerning existing dams and the impact of their failure is required to make a more comprehensive assessment of potential damages and mitigation strategies to address this potential damage.

Land Subsidence (Sinkholes)

Previous Occurrences

Gascosage's location in the southern half of Missouri places it squarely in a region where karst topography is common. This type of geological feature is characterized by springs, caves and sinkholes – the result of the collapse of a cave ceiling. While there are numerous identified sinkholes in the counties where the GEC service area is found, only 28 are known within the GEC boundaries (see Table 9). Although there have not been any reported incidents of sinkholes collapsing and causing personal injury or damage to Gascosage infrastructure, this type of land subsidence has occurred before in Missouri.

Table 9 *Sinkholes in the GEC Area*

County	Number of Sinkholes in each County	Number of Sinkholes Estimated in the GEC Service Area
Camden	82	0
Maries	9	0
Miller	10	0
Phelps	212	15
Pulaski	94	13
Totals	407	28
Source: 2014 data, Missouri Spatial Data Information Service		

Probability of Future Occurrence and Vulnerability

Determining the potential impact of land subsidence on CEC infrastructure is currently impossible due to a lack of historical data. Further study concerning land subsidence and its impact on power generation is required to make a more comprehensive assessment of potential damage. This analysis assumes a limited impact upon infrastructure of less than one percent, and less than one percent of service interruption.

Problem Statement

The fact that Gascosage does extensive engineering and environmental impact studies prior to construction of infrastructure reduces the potential threat of damage from land subsidence. If an incident of land subsidence occurred, it would be localized to a relatively small area which would further limit its impact on the cooperative.

C. Risk Assessment Summary

Most of the historical hazards have had an impact on the electric cooperatives. Table 10 below shows the annual damages associated with each hazard for GEC. The table is ranked by the highest Average Annual Damages which is an indication of the vulnerability to each hazard.

Table 10 *GEC Hazard Risk Summary*

Hazard	Average Annual Damages
Severe Winter Weather	$163,516
Flood and Levee Failure	$20,600
Tornadoes	$2,553
Dam Failure	$0
Earthquakes	$0
Hail	$0
Land Subsidence (Sinkhole Collapse)	$0
Severe Thunderstorms, and High Winds	$0
Wildfire	$0

Each of the non-historical hazards, Wildfire, Land Subsidence, Earthquakes and Dam Failure, have the potential for causing catastrophic damages in any given year. To date there have been zero damages to the assets of the Gascosage Electric Cooperative from the non-historical events. Nonetheless, this set of hazards should be considered in mitigation strategies because of the damage potential.

Section 4: Mitigation Strategies

Previous Mitigation Efforts

For organizations like Gascosage, 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. Historically, 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. However, this particular policy is currently under review. The cooperative is considering making customers partially responsible for replacement costs in flood-prone areas.

Existing and Potential Resources

As stated above, mitigation is a key component of good business practices. Gascosage 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 Gascosage 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, Gascosage 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
- USDA Economic Development Grants

Review of Goals and Actions

To focus on the mitigation actions for the 2023 update to this plan, it was decided to reach consensus on four goals that would address the needs of every cooperative member of AMEC and eliminate the

objectives from previous updates. The GEC mitigation staff reviewed these goals and the actions from the previous update which addressed hazard mitigation issues. They evaluated each action to decide if it was completed, will be continued, or should be deleted. There also was the opportunity to add new actions.

The staff considered which type of actions will maximize benefits and minimizes costs, how mitigation strategies will be implemented, and how the plan will be maintained and updated. Table 11 lists the goals as reviewed in the 2023 plan update.

Table 11 *Gascosage Goals 2023*

Identified Goals	Reassessment of the Goal 2023
Goal 1: Protect the health and safety of the community.	Accept, as is
Goal 2: Reduce future losses due to natural hazard events.	Accept, as is
Goal 3: Improve emergency management capabilities and enhance local partnerships.	Accept, as is
Goal 4: Continue to promote public awareness and education.	Accept, as is

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. Several action items could be included with multiple goals, for example. As a result, the cooperatives chose to use a different method to prioritize their mitigation strategy.

The chosen method of reviewing the proposed and existing mitigation strategies was to perform a cost-benefit analysis of all mitigation actions. The analysis was based on past experiences of performing certain actions and the potential number of beneficiaries. The following matrix, Table 12, was used to rate each mitigation action. Cooperative staff was asked in the Goals and Actions Survey to review the cost-benefit rating and change if necessary.

Table 12 *Cost Benefit Matrix*

COST	BENEFIT		
	High	Medium	Low
High	7	4	1
Medium	8	5	2
Low	9	6	3

The following tables represent the completed review of current and potential mitigation strategies. Each strategy has assigned a cost benefit score assigned by the cooperative staff based on prior experience and professional opinions. Table 14 shows review the actions and the results of the cost-benefit analysis. The table has been updated through the Goals and Actions Survey that was sent to facilitate the staff update review. The Survey can be found in Appendix C. Staff members reviewed each item on the original tables and determined the status of the item.

GASCOSAGE ELECTRIC COOPERATIVE

Table 13 *Prioritized Mitigation Actions for Gascosage Electric Cooperative – 2023*

Goal-Action #	Action Item	Status Update	Progress on Continued Actions	Hazards Addressed	Completion Date	Cost/Benefit Score
1-1	Use vegetation management to prevent interference with delivery of power and to prevent the public danger of downed lines	Continue (In-progress)	Ongoing as part of normal operations and annual maintenance planning.	Thunderstorms Tornado Winter Weather	Annually	8
1-2	Buy generators for use in special needs and critical facilities for use in outages	Continue (In-progress)	We assess critical loads and review this as an option.	Flooding Thunderstorms Tornado Winter Weather	Annually	8
2-1	Addition of lightning arresters, electronic reclosures, conductors, guidewires.	Continue (In-progress)	We practice an aggressive maintenance routine with frequent analysis and upgrades of line equipment and sectionalizing coordination.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	8
2-2	Upgrade to class IV wooden poles where possible.	Continue (In-progress)	By policy we have been upgrading to class IV wooden poles since May 2008 and setting poles in-line to shorten spans. We are also replacing 30/35 ft poles with taller poles where additional clearance is beneficial.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	8
2-3	Add alternate source wiring to eliminate or reduce time of outages. Upgrading lines to heavier wire (6A & 8A wire being replaced with 4 0 aluminum).	Continue (In-progress)	We budget annually for our in-house construction crews and outside contractors to perform system upgrades including electric line conversions to heavier wire.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	8
2-4	Convert overhead lines to underground lines or vice versa in troubled areas based on vulnerability and feasibility.	Continue (In-progress)	We assess problem areas and review this as an option. Since 2017 we have raised lines at river crossings and put up heavier gauge wire.	Flooding Thunderstorms Tornado Winter Weather	2027 or later	7
2-5	Research methods for waterproofing meters in flood-prone areas.	Continue (In-progress)	In flood prone areas, we install meter bases 10 ft above ground on the meter pole, when possible.	Flooding	Annually	6
2-6	Investigate the use of GPS for hazard mitigation planning purposes.	Continue (In-progress)	GPS locations enabled for entire system in 2016-2017 for MapWise and Outage Management System.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	7

GASCOSAGE ELECTRIC COOPERATIVE

Goal-Action #	Action Item	Status Update	Progress on Continued Actions	Hazards Addressed	Completion Date	Cost/Benefit Score
3-1	Maintain mutual aid agreements with other rural electric cooperatives.	Continue (In-progress)	We update our mutual aid agreement through Association of Missouri Electric Cooperatives annually.	Flooding Thunderstorms Tornado Winter Weather	Annually	9
3-2	Continue to partner with county emergency management agencies to ensure power for local shelters, fuel stations, and public safety.	Continue (In-progress)	We collaborate with local emergency services to ensure public health and safety whenever possible.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	9
3-3	Cooperate with local law enforcement and government officials to reduce the impact of power outages.	Continue (In-progress)	We collaborate with local law enforcement and government officials to ensure public health and safety whenever possible. We have also sent shape files of our boundaries to local counties for faster response times.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	9
4-1	Provide safety and reporting information to the general public through varying methods: Company website, social media sites, Local newspapers, Weekly radio spots, Presentations in cooperation with Show-Me Power, Publications	Continue (In-progress)	We primarily utilize social media platforms to provide safety and reporting information. However, the other methods continue to be utilized in communicating specific information.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	9
4-2	Monitor developments in data availability concerning the impact of all hazards upon the Gascosage service area through local, state, and federal agencies.	Continue (In-progress)	We work closely with NOAA on impending weather events as well as historical data on weather and the related damage to our electrical system.	Earthquakes Flooding Thunderstorms Tornado Winter Weather	Annually	9

After review, there was one action removed from the Action Items list for the plan update. All other actions are continued in the update. There are no additional actions added to the 2023 plan.

Table 14 *Actions Removed from the 2023 GEC Update*

Actions Item	Status Update	Explanation for Completed/Deleted Action
Complete inspections every 3 years on lines and poles.	Delete this action	Ongoing as part of normal operations and annual maintenance planning.

Section 5: Plan Implementation and Maintenance

Plan incorporation

The goals and actions of the previous section identify both ongoing efforts at mitigation and potential methods for expanding efforts. The updated 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 Gascosage employment level as the organization strives to ensure quality service to their customers.

Local Planning Capabilities

Some internal planning capabilities do exist at Gascosage. The Hazard Mitigation Plan can be considered and/or incorporated into regular budgetary planning, the four-year work plan for capital improvements, and the maintenance planning policy. Planning capabilities per se for the electric cooperatives are limited. What is important is that the Action Items developed through the mitigation planning process are incorporated into the daily activities of the cooperative.

The four-year work plans embrace the mitigation efforts that are in the mitigation plan. The electric cooperatives across Missouri are always working to strengthen their systems. This would include installing stronger/larger poles when smaller ones need to be changed out, installing stronger/larger conductors that can carry more weight and decreasing span lengths between poles, installing larger anchors, relocating structures out of flood plains, and installing structures to stop cascading during ice storms.

Other capabilities are unique to the electric cooperative's business of providing reliable electricity to their members. Many of the Action Items listed in the plan include tree trimming plans, use of GPS to locate outages, service upgrades to lines and poles, warning systems and use of weather radios, collection of GIS data and utility specific software for locating and rerouting outages to restore power, all contribute to local capabilities. Integration of Gascosage's planning with local law enforcement, mutual aid agreements, and partnerships with local emergency management resources ensures power to critical facilities during a hazard event. This coordination and cooperation broaden the capabilities of the local cooperative.

Beyond the Gascosage Hazard Mitigation Plan, regional planning capabilities exist at the local level. The Missouri counties of Camden, Maries, Miller, Phelps and Pulaski 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). Gascosage's plan can be easily incorporated into these local plans and allow for coordination across agencies in the event of an emergency.

Gascosage is located within the rural portions of third-class counties which are prohibited from enforcing building codes and zoning by the state of Missouri. The cooperative provides service to the communities of Crocker, Dixon, Iberia, Jerome, Newburg, Brumley, Swedeborg, Hancock, Hawkeye, Ullman and Doolittle. None of these very small communities currently have comprehensive plans or capital improvement plans in place.

Plan Maintenance

Gascosage will follow the requirements coordinated by the Association of Missouri Electric Cooperatives (AMEC) for monitoring, evaluating, and updating the plan.

Continued Public Involvement Opportunities

Public notice was given in the form a notice in the *Rural Missouri*, a publication of the Association of Missouri Electric Cooperatives, distributed to all cooperative members. The updated 2023 plans were posted on the website of the Northwest Missouri Regional Council of Governments for public review and comment. Comments were considered and addressed. Once all co-op plans were completed, they were assembled into one plan and submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval. The documentation for public involvement and comments can be found in Appendix B of each cooperative's section of the plan.

Gascosage will follow to the requirements coordinated 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 and the physical office of Gascosage.

Appendix: A – Adoption Resolutions

RESOLUTION

HAZARD MITIGATION PLAN

(CORPORATE SEAL)

Appendix: B - Documentation of Participation

This ad was published in the *Rural Missouri*, a monthly publication of the Missouri Association of Missouri Electric Cooperatives, giving public notice to all subscribing members of AMEC.

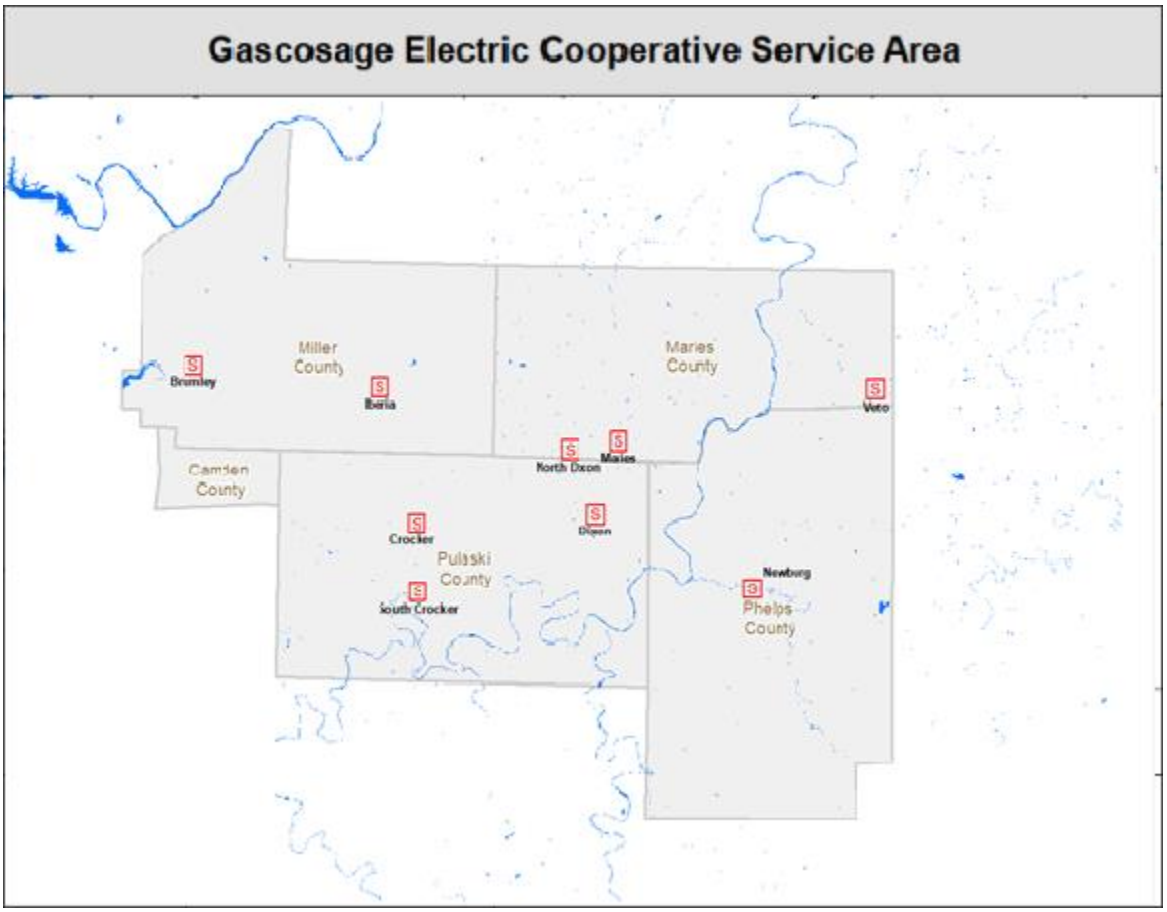
Appendix: C - Surveys

Data Survey

The following is the returned survey from TCEC which was used by NWMORCOG staff to update the Plan:

Gascosage Electric Cooperative (Gascosage or GEC) was established in 1938 to provide electric service to the rural areas of south-central Missouri. ~~A Touchstone Energy Cooperative,~~ Gascosage is headquartered in Dixon, Missouri, and provides service to members in portions of Maries, Miller, Phelps, Pulaski and Camden counties in Missouri. The cooperative owns 1584 miles of service line within these counties as of December 2021. The cooperative is run by a board of nine directors which approve the company's mission and internally developed business policy

> *"Gascosage Electric Cooperative provides our diverse membership an unsurpassed level of comprehensive service using the latest proven technological advances in the electrical industry to deliver reliable and affordable electricity in the traditional style of personalized service."*



The customer base of Gascosage is 9871 members. Residential customers account for 91 percent of memberships (8,983 meters) while non-residential customers make up the remaining 9 percent (888 meters).

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Meters by Missouri County

County	Number of Meters
Camden	9
Maries	1112
Miller	3041
Phelps	1344
Pulaski	4365
Total	9871

The average daily customer usage for Gascosage is 55 kilowatt-hours (kWh). Annual total usage of Gascosage customers in 2021 was 200,681,513 kWh of service.

Critical Facilities It is important in mitigation planning for the electric cooperatives to identify the critical facilities in each area and to be able to prioritize reconnection and back-up power needs. Gascosage provides service to two nursing homes, one ambulance district in Dixon and fire stations in Dixon, Crocker, Swedeborg and Iberia. Gascosage does not provide service to any higher education institutions, or large industrial centers.

Future Development:

Gascosage has a member showing interest in a bitcoin mining facility that will increase our kWh usage by a third.

Gascosage Electric Cooperative has a wide variety of assets by type. Real estate owned by the company includes office buildings, garages, and other outbuildings located in Dixon. Thirty-Three vehicles provide access to customers and infrastructure. Gascosage does not own any electric generation or transmission infrastructure; 1,584 miles of distribution lines are owned and maintained by Gascosage. Table ? provides information concerning total asset valuation.

Gascosage Asset Inventory Valuation Summary

Asset	Total Replacement Cost	Cost Breakdown
Total Gascosage Assets	$149,872,464	Buildings and contents – $8,284,104 Vehicles and trailers - $2,158,139 Power Operated Equipment - $2,285,609 Communications Equipment - $104,552 Overhead assets - $41,820,020 Underground assets - $185,856
Distribution Lines	$41,820,020 OH $185,856 UG	OH Single-phase lines - $25,787,520 UG Single-phase lines - $176,055 OH Three-phase lines - $16,032,500 UG Three-phase lines - $9,801
Supporting Infrastructure	$95,034,184 OH	Meters - $2,990,913 Poles - $55,764,060 Transformers - $16,643,792 Guys - $3,311,078 Anchors - $13,831,675 Cross-arms - $1,233,716 Reclosers - $998,250 Regulators - $161,700 Capacitors - $99,000
Office Buildings and contents	$8,284,104	
Vehicles	$2,158,139	
Source: Distribution – Engineers/GIS System, Other Assets-Accounting/GL Records		

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GEC Asset Inventory by Service County

County	Emergency Replacement Cost per unit or mile	Number of units or miles: CAMDEN	Number of units or miles: MARIES	Number of units or miles: MILLER	Number of units or miles: PHELPS	Number of units or miles: PULASKI	Number of units or miles: TOTAL
Meters	$303/unit	9	1,112	3,041	1,344	4,365	9,871
Poles	$1,815/unit	83	4,850	10,027	4,434	11,330	30,724
SP*** Distribution Line	$19,360/mile OH $90,750/mile UG	6 OH** 0 UG	236 OH 0.5 UG***	426 OH 0.29 UG	211 OH 0.85 UG	453 OH 0.3 UG	1,332 OH 1.94 UG
TP**** Distribution Line	$64,130/mile OH $163,350/mile UG	0 OH 0 UG	31 OH 0 UG	73 OH 0.06 UG	37 OH 0 UG	109 OH 0 UG	250 OH 0.06 UG
Transformers	$1,936/each OH	24 OH	1,062 OH	2,926 OH	1,152 OH	3,433 OH	8,597 OH
Guys/ anchors	$149/unit $715/unit	53 53	2,947 2,724	8,083 6,772	3,428 2,957	7,711 6,839	22,222 19,345
Cross-arms	$242/ each	0	561	1,666	654	2,217	5,098
Regulators	$5,390/each	0	6	10	5	9	30
Reclosers	$3,630/each	0	48	87	38	102	275
Capacitors	$3,300/unit	0	6	10	5	9	35
Total Replacement Value by County		$361,788 OH $0 UG	$20,501,613 OH $45,375 UG	$44,566,243 OH $36,119 UG	$20,107,669 OH $77,138 UG	$51,316,890 OH $27,225 UG	$136,854,203 OH $185,857 UG

**OH = overhead ***UG = underground ***SP = Single phase ****TP – Three phase
Source: Internal Gascosage Accounting and Maintenance records

GEC did not provide any additional information regarding the damages from hazards for this update.

Goals and Actions Survey

The original survey is an interactive Excel file that could not be inserted without stabilizing the formatting. All of the data submitted is included in the tables below.

Complete each row left to right. Click on each box to receive instructions for that box.	Goals	Reassess the goal	Instructions	Justifications for modifying
→	**Goal 1**: Protect the health and safety of the community	accept, as is ☑ yes	If you chose to remove or modify the goal, please give your reasons in the box to the right.	
→	**Goal 2**: Reduce future losses due to natural hazard events.	accept, as is ☑ yes	If you chose to remove or modify the goal, please give your reasons in the box to the right.	
→	**Goal 3**: Improve emergency management capabilities and enhance partnerships.	accept, as is ☑ yes	If you chose to remove or modify the goal, please give your reasons in the box to the right.	
→	**Goal 4**: Continue to promote public awareness and education.	accept, as is ☑ yes	If you chose to remove or modify the goal, please give your reasons in the box to the right.	
↘	**After completing this sheet, please click the "actions" tab at the bottom**			

Table 1 *GEC Hazard Risk Summary*

Hazard	Average Annual Damages
Severe Winter Weather	$225,000
Flood and Levee Failure	$75,000
Tornadoes	$15,000
Dam Failure	$0
Earthquakes	$0
Hail	$0
Land Subsidence (Sinkhole Collapse)	$0
Severe Thunderstorms, and High Winds	$225,000
Wildfire	$0

goals actions

Goal-Action	Action Item	Status Update	Progress on Continued Actions	Hazards Addressed by This Action	Completion Date	Cost/Benefit Score
2-1	Addition of lightning arresters, electronic reclosures, conductors, guidewires.	Continue (In-progress)	We practice an aggressive maintenance routine with frequent analysis and upgrades of line equipment and sectionalizing coordination.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	8
2-2	Upgrade to class IV wooden poles where possible.	Continue (In-progress)	By policy we have been upgrading to class IV wooden poles since May 2008 and setting poles in-line to shorten spans. We are also replacing 30/35 ft poles with taller poles where additional clearance is beneficial.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	8
1-1	Use vegetation management to prevent interference with delivery of power and to prevent the public danger of downed lines	Continue (In-progress)	Our highly trained ROW crews operate 2 Skytrims and 1 Klearway 500 on a 7 year rotation throughout our service territory.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	8
2-3	Add alternate source wiring to eliminate or reduce time of outages. Upgrading lines to heavier wire (6A & 8A wire being replaced with 4 0 aluminum).	Continue (In-progress)	We budget annually for our in-house contstruction crews and outside contractors to perform system upgrades including electric line conversions to heavier wire.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	8
2-4	Convert overhead lines to underground lines or vice versa in troubled areas based on vulnerability and feasibility.	Continue (In-progress)	We assess problem areas and review this as an option. Since 2017 we have raised lines at river crossings and put up heavier gauge wire.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	2027 or later	7
4-1	Provide safety and reporting information to the general public through varying methods: • Company website • Social media sites • Local newspapers • Weekly radio spots • Presentations in cooperation with Show-Me Power • Publications	Continue (In-progress)	We primarily utitlize social media platforms to provide safety and reporting information. However, the other methods continue to be utilized in communicating specific information.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	9
1-2	Buy generators for use in special needs and critical facilities for use in outages	Continue (In-progress)	We assess critical loads and review this as an option.	Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	8

3-1	Maintain mutual aid agreements with other rural electric cooperatives.	Continue (In-progress)	We update our mutual aid agreement through Association of Missouri Electric Cooperatives annually.	Dam Failure Earthquakes **Flooding** Land Subsidence Levee failure **Thunderstorms** **Tornado** Wildfire **Winter Weather**	annually	9
3-2	Continue to partner with county emergency management agencies to ensure power for local shelters, fuel stations, and public safety.	Continue (In-progress)	We colaborate with local emergency services to ensure public health and safety whenever possible.	Dam Failure **Earthquakes** **Flooding** Land Subsidence Levee failure **Thunderstorms** **Tornado** Wildfire **Winter Weather**	annually	9
3-3	Cooperate with local law enforcement and government officials to reduce the impact of power outages.	Continue (In-progress)	We colaborate with local law enforcement and government officials to ensure public health and safety whenever possible. We have also sent shape files of our boundarys to local counties for faster response times.	Dam Failure **Earthquakes** **Flooding** Land Subsidence Levee failure **Thunderstorms** **Tornado** Wildfire **Winter Weather**	annually	9
2-5	Research methods for waterproofing meters in flood-prone areas.	Continue (In-progress)	In flood prone areas, we install meter bases 10 ft above ground on the meter pole, when possible.	Dam Failure Earthquakes **Flooding** Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather	annually	6
2-6	Investigate the use of GPS for hazard mitigation planning purposes.	Continue (In-progress)	We utilize the GIS of our distribution system to identify areas of previous damage and future vulnerabilities.	Dam Failure **Earthquakes** **Flooding** Land Subsidence Levee failure **Thunderstorms** **Tornado** Wildfire **Winter Weather**	annually	7
4-2	Monitor developments in data availability concerning the impact of all hazards upon the Gascosage service area through local, state, and federal agencies.	Continue (In-progress)	We work closely with NOAA on impending weather events as well as historical data on weather and the related damage to our electrical system.	Dam Failure **Earthquakes** **Flooding** Land Subsidence Levee failure **Thunderstorms** **Tornado** Wildfire **Winter Weather**	annually	9
	New Action (optional)			Dam Failure Earthquakes Flooding Land Subsidence Levee failure Thunderstorms Tornado Wildfire Winter Weather		