Las Animas County

Office of Emergency Management

Las Animas County Hazard Mitigation Plan

DRAFT September, 2016

Las Animas County Office of Emergency Management. | 200 East 1st St., Room 106, Trinidad, CO 81082
www.lasanimascounty.net

Las Animas County
HAZARD MITIGATION PLAN

DRAFT

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Prepared for:
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Las Animas County
Hazard Mitigation Plan

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA) is federal legislation that requires proactive, pre-disaster planning as a prerequisite for some funding available under the Robert T. Stafford Act. The DMA encourages state and local authorities to work together on pre-disaster planning. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Hazard mitigation is the use of long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. It is impossible to predict exactly when and where disasters will occur or the extent to which they will impact an area, but with careful planning and collaboration among public agencies, stakeholders, and citizens, it is possible to minimize losses that disasters can cause. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government.

Las Animas County and a partnership of local jurisdictions within the county (including the City of Trinidad, the Towns of Aguilar and Cokedale, and the Stonewall Fire Protection District) are developing and will maintain a hazard mitigation plan (HMP) to reduce risks from natural disasters and to comply with the DMA.

PLAN DEVELOPMENT

Federal regulations require monitoring, evaluation, and updating of hazard mitigation plans. An update provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and evaluate whether there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is no longer in compliance with the DMA.

The development of this new plan specific to Las Animas County consisted of the following phases:

Phase 1, Organize and Review—A planning team was assembled to provide technical support for the plan update, consisting of key county staff from the Las Animas County Office of Emergency Management and a technical consultant. The first step in developing the plan was to establish the participating jurisdictions as the unincorporated Las Animas County, the City of Trinidad, the Towns of Aguilar and Cokedale, and the Stonewall Fire Protection District. A Steering Committee was assembled to oversee the plan development, consisting of participating jurisdiction staff and community representatives from the planning area. Coordination with other county, state, and federal agencies involved in hazard mitigation occurred throughout the plan update process. This phase included a comprehensive review of the *2013 Colorado Natural Hazards Mitigation Plan* and existing programs that may support or enhance hazard mitigation actions.

Phase 2, Risk Assessment—Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, and infrastructure to natural hazards. All facets of the risk assessment of the plan were re-visited by the planning team and updated with the best available data and technology. The work included the following:

- Hazard identification and profiling
- Assessment of the impact of hazards on physical, social, and economic assets
- Vulnerability identification
- Estimates of the cost of potential damage

Phase 3, Engage the Public—A public involvement strategy agreed upon by the Steering Committee was implemented by the planning team and the Steering Committee meetings were open to the public. Participation in the hazard mitigation survey occurred across the county.

Phase 4, Assemble the Plan—The planning team and Steering Committee assembled key information into a document to meet the DMA requirements for all planning partners.

Phase 5, Adopt/Implement the Plan—Once pre-adoption approval has been granted by the Colorado Division of Homeland Security and Emergency Management (DHSEM) and Region VIII of the Federal Emergency Management Agency (FEMA), the final adoption phase will begin. Each planning partner will individually adopt the updated plan. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every 5 years. Throughout the life of this plan, a representative of the original Steering Committee will provide a consistent source of guidance and oversight.

MITIGATION GOALS AND OBJECTIVES

The following overarching goal guided the Steering Committee during the plan update:

> **To reduce or eliminate the long-term risks to loss of life and property damage in the county from natural disasters**

The following plan goals and objectives were determined by the Steering Committee:

- **Goal 1:** Protection of people, property, and natural resources.
  - **Objective 1.1:** Develop projects focused on preventing loss of life and injuries from natural hazards
  - **Objective 1.2:** Identify and prioritize actions to protect critical, essential, and necessary assets, infrastructure, and cultural resources
  - **Objective 1.3:** Protect and enhance natural resources
  - **Objective 1.4:** Identify and expand emergency services protocols for people who are at high risk from hazard events, such as the homeless, elderly, disabled, and oxygen-dependent people

Goal 2: Increase awareness of natural hazards and their mitigation.

  - **Objective 2.1:** Continue to develop and expand public awareness and information programs
  - **Objective 2.2:** Expand public awareness of flood and flash flood hazards in general and at specific high-risk locations
  - **Objective 2.3:** Expand public awareness of wildfire hazards and measures by which people can protect themselves, their property, and their community
  - **Objective 2.4:** Educate elected officials, agency administrators, and business owners on mitigation strategies and best practices

- **Goal 3:** Coordinate and integrate hazard mitigation activities.
  - **Objective 3.1:** Strengthen connections between hazard mitigation activities; and preparedness, response, and recovery activities
  - **Objective 3.2:** Identify existing local government monitoring and decision-making tools; identify gaps and needed improvements
  - **Objective 3.3:** Strengthen collaboration with neighboring communities, non-governmental agencies, and businesses to improve hazard response capabilities and resources

  - **Objective 3.4:** Develop systems to identify hazard-prone areas and affected populations and track people and resources before and during a natural hazard event

For this plan, the Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to those hazards was also used. Based on the review, this plan addresses the following natural hazards of concern:

- Avalanche
- Dam/Levee Failure
- Drought
- Earthquake
- Erosion and Deposition
- Expansive Soil
- Extreme Heat
- Flood
- Hail
- Landslide, Mud/Debris Flow, Rockfall
- Lightning
- Severe Wind
- Subsidence
- Tornado
- Wildfire
- Winter Storm

Several of these hazards were profiled together because of their common occurrence or damage assessments, such as drought and extreme heat, and hail, lightning, and severe winds.

MITIGATION ACTIONS

Mitigation actions presented in this plan are activities designed to reduce or eliminate losses resulting from natural hazards. The plan update process identified 41 mitigation actions for implementation by individual planning partners as listed in Table ES-1. The Steering Committee ranked the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on the table, medium priority actions are shown in yellow, and low priority actions are shown in green.

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Hazards Addressed	Action Type	Applicable Goals and Objectives	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline
LAS ANIMAS COUNTY										
1	Purchase Back-up Generators	The County will purchase two portable back-up generators for shelter locations.	12	Avalanche; Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	OEM	$10,000 to $100,000	County budget, FEMA HMA	Short Term
2	Construct New EOC	The County wants to move the EOC to a brick building at 1st and Maple that is a larger space and it is outside the 100-year floodplain. The building already houses the Trinidad Police Department.	1	Avalanche; Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	OEM	$10,000 to $100,000	FEMA HMA	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

3	Evacuation Plan Including Functional and Access Needs Population	The County plans to develop and implement an Evacuation Plan that includes Functional and Access Needs Population. The County will work with the American Red Cross to get this completed.	2	Avalanche; Dam/Levee Failure; Flood; Tornado; Wildfire; Winter Storm	LPR EAP	Goal: 1, 3 Obj: 1.4, 3.1, 3.2	OEM	< $10,000	County budget, ARC	Short Term
4	Educate Homeowners on Drought Conservation Measures	The County will educate homeowners on drought conservation measures using the county website and public events.	10	Drought	EAP	Goal: 1, 2 Obj: 1.1, 2.1, 2.4	OEM	< $10,000	County budget	Short Term
5	Purchase Crop Insurance	Preserve economic stability during drought and other natural hazard events by encouraging farmers to obtain crop insurance to cover potential losses due to the event. The County will provide educational materials at public events and in the county offices.	6	Drought, Flood, Hail, Lightning, Wildfire, Winter Storm	EAP	Goal: 2 Obj: 2.1	OEM	< $10,000	County budget	Long Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

6	Adopt 2015 IBC and IRC	The County will adopt the 2015 IBC and IRC standards.	8	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	LPR	Goal: 3 Obj: 3.1, 3.2	Building Dept.	< $10,000	County budget	Short Term
7	Update FIRMs	The County will work with the Colorado Water Conservation Board to get FIRMs updated for the county.	7	Flood	LPR	Goal: 1, 3 Obj: 1.1, 1.3, 3.1	Department of Land Use/Land Use Officer	$10,000 to $100,000	County budget, CWCB, FEMA Risk MAP	Short Term
8	Perform Exercise on Trinidad Dam Emergency Action Plan	The County will work with the City of Trinidad to plan and execute an exercise on the Trinidad Emergency Action Plan Dam notification procedures and expected actions.	4	Dam Failure	LPR EAP	Goal: 1, 2, 3 Obj: 1.4, 2.2, 2.4, 3.1	OEM	< $10,000	County budget	Short Term
9	Purchase Outdoor Warning Siren	The County will purchase and install outdoor warning sirens for the Kim area to give homeowners proper	11	Hail; Lightning; Severe Wind; Tornado; Wildfire	SIP	Goal: 1 Obj: 1.1	OEM	$10,000 to $100,000	County budget, FEMA HMA	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

		warning time for weather events.								
10	Create MOUs with Neighboring Counties	The County will develop and sign MOUs with neighboring counties to help with emergency assistance, in particular snow removal during blizzard events.	9	Avalanche; Dam/Levee Failure; Earthquake; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.2, 3.3	OEM	< $10,000	County budget	Short Term
11	Install Lightning Rods on County Facilities	The County will purchase and install lightning rods to put on critical county facilities to protect from lightning damage.	5	Lightning	SIP	Goal: 1 Obj: 1.1, 1.2	OEM	< $10,000	County budget, state and federal grants	Short Term
12	Fire Protection Districts to Create, Maintain, and Implement CWPPs	The County will work with all the fire protection districts in Las Animas County to create, maintain, and implement CWPPs and implement wildfire mitigation measures to minimize the wildfire threat.	3	Wildfire	LPR	Goal: 1, 2 Obj: 1.1, 2.3	OEM	< $10,000	State and federal grants	Short Term
CITY OF TRINIDAD										
1	Retrofit Existing Dedicated Space for PD EOC	Upgrade the dedicated space with enough phone lines (26+), desks, tables, area for maps, internet, sleep quarters, showers, kitchen for food prep, televisions – in accordance with the EOP.	1	Avalanche; Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind;	SIP	Goal: 3 Obj: 3.3	Police Department	$10,000 to $100,000	Grants and CIP money	Short Term

**TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS**

				Tornado; Wildfire; Winter Storm						
2	Provide Back-up Generators for Critical Infrastructures	Purchase and install back-up generators at: 1) the two fire stations, 2) City Hall where the servers are stored (they operate our CAD/RMS systems that are used by all emergency services), and 3) Police Department to support/improve the redundant communication center.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1	City Public Safety Manager	$10,000 to $100,000	HMP Grants and CIP money	Short Term
3	Install Outdoor Warning Sirens	The City would like to purchase a minimum of 4, and up to 12, outdoor warning sirens to cover the entire city limits. Then the City can install and training personnel on the sirens. The City of Trinidad currently has no outdoor warning sirens.	8	Avalanche; Dam/Levee Failure; Earthquake; Flood; Hail; Lightning; Severe Wind; Tornado; Wildfire	SIP	Goal: 1 Obj: 1.2	Fire/Police Department	>$100,000	Grants (CIP Matching)	Short Term
4	Upgrade Emergency Shelters to Meet Functional and Access Needs Standards	The existing emergency shelters (Trinidad Community Center and Sayre Senior Center) need to meet or exceed the needs of the entire population to include functional and access needs in order to reduce or eliminate the long-term risks to loss of life from natural disasters as well as	2	Avalanche; Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, Obj: 1.1, 1.4	City Public Safety Manager	>$100,000	Capital Improvement Funds and Grants	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

		satisfy state and local regulations.								
5	Wildfire Education and Awareness Programs	Schedule workshops for residents and advertise with flyers, ads, and radio. The workshops would provide education to residents on how to protect themselves, their property and their community from wildfire-urban interface.	9	Wildfire	EAP	Goal: 2 Obj: 2.3	Fire Department	< $10,000	State and Federal Grants	Ongoing
6	Localized Flood Reduction Project	The City of Trinidad shall minimize debris and back-up in drainage areas by maintaining and removing debris near or on localized dam areas.	10	Dam/Levee Failure, Flood	SIP	Goal: 1, 2 Obj: 1.1, 2.2	City Public Safety Manager	$10,000 to $100,000	Budgetary line expenses, Capital Improvement Funds and Grants	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

7	Upgrade Electrical Infrastructure	The City of Trinidad will: 1) mitigate and bury overhead electrical lines, 2) fortify substation upgrades, 3) voltage conversions, and 4) maintain and upgrade existing underground facilities as needed.	7	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds and Grants	Long Term
8	Upgrade Utility Sewer Infrastructure	The City of Trinidad will: 1) remove old ductile iron, and asbestos cement pipelines and replace with Schedule 35 plastic pipe, 2) fortify sewer lift stations, 3) install two additional lift stations within collection system and Mission Control System, 4) upgrade the existing SCADA system, and 5) maintain and upgrade existing underground facilities as needed.	6	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds and Grants	Long Term

**TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS**

9	Upgrade Utility Water Infrastructure	The City of Trinidad will: 1) remove old galvanized, cast iron, steel, ductile iron, and asbestos cement pipelines and replace with C-900 pipelines, 2) fortify water pump stations, 3) fortify regulating stations, 4) fortify water storage tanks, and 5) maintain and upgrade existing underground facilities as needed.	4	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds and Grants	Long Term
10	Upgrade Gas Utility Infrastructure	The City of Trinidad will: 1) remove all steel pipelines and uncoated gas pipelines, 2) fortify gas regulating stations, 3) fortify and redesign existing power plant regulating station, and 4) maintain and upgrade existing underground facilities as needed.	5	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds and Grants	Long Term
TOWN OF AGUILAR										
1	Purchase Back-up Generator	The Town of Aguilar will purchase and install a permanent back-up generator for the Aguilar Housing Authority that has 18 residential units.	1	Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	Town Clerk	$10,000 to $100,000	FEMA's HMA grants	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

2	Registry Database for Functional and Access Needs	The Town of Aguilar will create and implement a registry database for the functional and access needs population to register their needs. This will allow the Marshal and volunteers to assist those in need during and after a hazard event.	4	Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.4	Town Clerk	< $10,000	Town budget, state grants, ARC	Short Term
3	Create a CERT team	The Town of Aguilar will enlist a CERT group of volunteers under the direction of the Marshal to check-in on and assist the functional and access needs population that have registered with the Town.	3	Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.2	Marshal's Office	< $10,000	Town budget, state grants	Short Term
4	Create MOA for Emergency Water	The Town of Aguilar will create a MOA with the Cities of Trinidad and Walsenburg for drinking water. The MOA could then be executed in times of need as a secondary potable water source.	5	Drought	LPR	Goal: 1, 3 Obj: 1.1, 3.1, 3.3	Town Clerk	< $10,000	Town budget, state grant	Short Term
5	Create and Implement a Drought Response Plan	The Town of Aguilar will create and implement a Drought Response Plan with drought stage contingency measures. The plan's drought stage measures would be adopted by the town and the residents would be required to adhere to the drought stage measures.	2	Drought	LPR EAP	Goal: 1, 2 Obj: 1.1, 2.4	Town Clerk	< $10,000	Town budget	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

6	Hail Education to Homeowners	The Town of Aguilar will educate homeowners about the dangers of hail and how to mitigate hail damage with hail-resistant roof coverings, flashing in building designs, etc.	6	Hail	EAP	Goal: 1, 2 Obj: 1.1, 2.1	Town Clerk	< $10,000	Town budget	Short Term
TOWN OF COKEDALE										
1	Hardening and Retrofitting the Mercantile Building for Use as an EOC	Engineer, design, and construct a retrofitted and hardened EOC for the town. The Mercantile building will be retrofitted and hardened by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire-resistant plants; implementing higher standards for foundations, and using R-value building materials to resist heat.	1	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, 3 Obj: 1.2, 3.1	Town of Cokedale/ Administration	>$100,000	FEMA, HMA, DOLA, CDBG	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

2	Public Education of all Hazards	Supply educational pamphlet to residents so they can mitigate their homes from natural hazard events.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	EAP	Goal: 2 Obj: 2.1, 2.4	Town Clerk	< $10,000	State and federal grants	Short Term
3	Back-up Generator	The Town of Cokedale will purchase and install back-up generators for the waste water lagoons, the training center, and the Mercantile Building.	2	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.2	Town Clerk	$10,000 to $100,000	State and federal grants	Short Term
4	Create Defensible Space Around Homes	Educate and provide man-power to assist homeowners with clearing space around their property to mitigate wildfires.	4	Wildfire	EAP NSP	Goal: 1, 2, 3 Obj: 1.1, 2.3, 3.3	Town Clerk	< $10,000	State and federal grants	Short Term
5	Thin Brush and Trees	Provide the man-power and tools to clear brush and dead trees that can be ignited in a wildfire.	5	Wildfire	EAP NSP	Goal: 1, 2, 3 Obj: 1.1, 2.3, 3.3	Town Clerk	< $10,000	State and federal grants	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

STONEWALL FIRE PROTECTION DISTRICT										
1	Wildfire Education	This jurisdiction is a wildland urban interface, covering 547 square miles of which 75% is overgrown forest sloping down into oak brush, sage and grasses. The FPD will work with their current CWPP to provide education and information programs such as partnerships with Landowner Associations and Homeowner Associations to implement addition CWPP, fire prevention education program in the schools, the public, and incessant work with the Colorado State Forest Service.	1	Wildfire	EAP	Goal: 1, 2, 3 Obj: 1.1, 1.3, 2.1, 2.3, 3.1	Stonewall Fire Protection District, Central Office	< $10,000	FEMA, USDA, State Forestry Dept.	Ongoing
2	Wildfire Thinning Brush	Coordinate thinning of the forest on public and private lands at priority locations within the FPD once a grant is secured.	2	Wildfire	NSP	Goal: 1, 3 Obj: 1.1, 1.3, 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	FEMA, USDA, State Forestry Dept.	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

3	Construct Hardened Central Fire Station	The FPD will hire a contractor to engineer, design, and construct a hardening fire station. The fire station will be hardened to withstand seismic activity, wind, hail, winter storm by applying a higher standard for the foundation and upgrading the requirements on the construction of beams, supports, roof, bay doors, insulation, installing lighting rods and grounding systems; using low-flow plumbing to conserve water; landscape with drought and fire resistant plants; and using R-value building materials to resist heat. The Central Station will also serve as an emergency facility to facilitate community needs such as power, water, and a safe place to congregate before, during, and after a hazardous event.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, 3 Obj: 1.1, 1.3, 1.4, 3.1	Stonewall Fire Protection District, Central Office	>$100,000	FEMA, USDA, State Forestry Dept.	Short Term
4	Earthquake Education	Incorporate earthquake awareness and information into our current outreach programs. Continue to monitor earthquake data and share	4	Earthquake	EAP	Goal: 2 Obj: 2.1	Stonewall Fire Protection District, Central Office	< $10,000	FEMA, district funds	Ongoing

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

		information with the public. Develop strategies to implement post-disaster actions. County planning and zoning to implement and enforce upgraded building codes.								
5	Lightning Education	Educate with printed materials the public and fire fighters with data on life safety during storms.	5	Lightning	EAP	Goal: 2 Obj: 2.1	Stonewall Fire Protection District, Central Office	< $10,000	Local funds	Ongoing
6	Dam Failure Education	Provide dam failure and flood hazard education for the public by mailings of brochures, handing out information at events, i.e.; Trinidad Water Festival to mitigate damages to property and homes.	8	Dam/Levee Failure; Flood	EAP	Goal: 2 Obj: 2.2	Stonewall Fire Protection District, Central Office	< $10,000	Local funds	Ongoing
7	Severe Wind Property Assessments	Provide home and property assessments for potential wind damage to ranchers and homeowners in the district. Public education to homeowners on mitigating homes and properties for the potential of wind damage.	6	Severe Wind, Tornado	EAP	Goal: 1, 3 Obj: 1.1, 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	District Funds	Short Term

TABLE ES-1.
RECOMMENDED MITIGATION ACTIONS

8	Winter Storm Education	Provide public education and information to homeowners on winter weather mitigation measures for their homes and property. Also offer assessments and mitigation of properties for winter storms.	7	Winter Storm	EAP	Goal: 3 Obj: 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	FEMA, USDA	Ongoing

ARC	American Red Cross	FPD	Fire Protection District
CDBG	Community Development Block Grant	HMA	Hazard Mitigation Assistance grants
CERT	Community Emergency Response Team	IBC	International Building Code
CIP	Capital Improvement Program	IRC	International Residential Code
CWCB	Colorado Water Conservation Board	LPR	Local Plans and Regulations
CWPP	Community Wildfire Protection Plan	MOA	Memorandum of Agreement
DFIRM	Digital Flood Insurance Rate Map	MOU	Memorandum of Understanding
DOLA	Colorado Department of Local Affairs	NSP	Natural System Protection
EAP	Education and Awareness Programs	OEM	Office of Emergency Management
EOC	Emergency Operations Center	PD	Police Department
EOP	Emergency Operations Plan	SIP	Structure and Infrastructure Project
FEMA	Federal Emergency Management Agency	USDA	U.S. Department of Agriculture
FIRM	Flood Insurance Rate Map		

PART 1—
PLAN ELEMENTS AND PARTICIPATING COMMUNITIES

CHAPTER 1.
INTRODUCTION

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

Hazard mitigation is defined as a way to alleviate the loss of life, personal injury, and property damage that can result from a disaster through long- and short-term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government.

The Federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) required state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Prior to 2000, federal disaster funding focused on disaster relief and recovery, with limited funding for hazard mitigation planning. The DMA increased the emphasis on planning for disasters before they occur.

The DMA encourages state and local authorities to work together on pre-disaster planning. It promotes "sustainable hazard mitigation," which includes the sound management of natural resources and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects. This hazard mitigation plan was prepared for unincorporated Las Animas County and the participating communities of the City of Trinidad, the Towns of Aguilar and Cokedale, and the Stonewall Fire Protection District to reduce risks from natural disasters and to comply with the DMA (Figure 1-1).

1.1.2 Local Concerns

Several factors initiated this planning effort:

- Las Animas County is exposed to hazards that have caused past damage.
- Limited local resources make it difficult to be pre-emptive in reducing risk. Eligibility for federal financial assistance is paramount to promote successful hazard mitigation in the area.
- Las Animas County and its planning partners want to be proactive in preparing for the probable impacts of natural hazards.
- Las Animas County does not currently have a FEMA-approved mitigation plan in place, which could limit access to emergency funds after a disaster declaration.

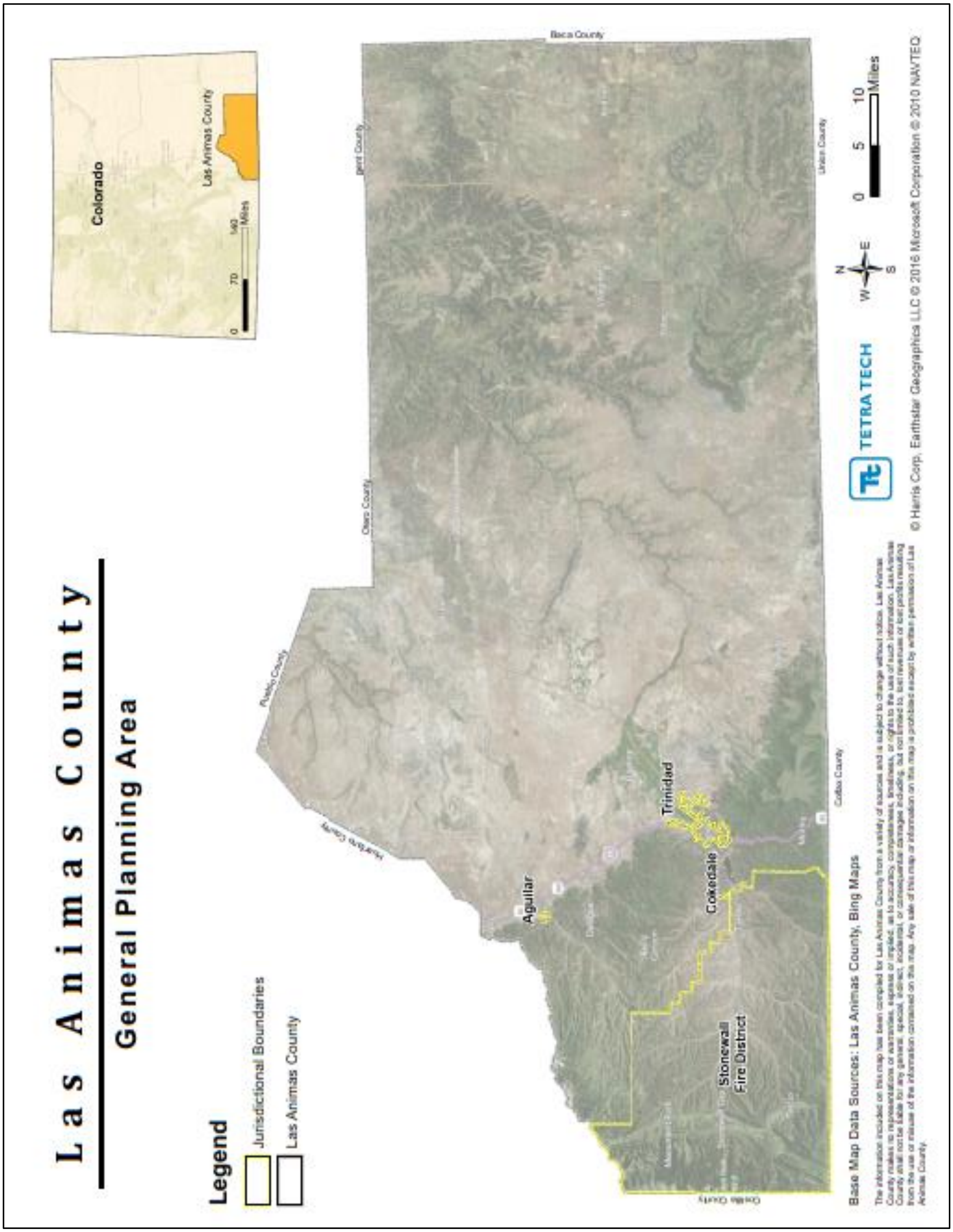


Figure 1-1. Las Animas County and Participating Communities

1.1.3 Purposes for Planning

This hazard mitigation plan identifies resources, information, and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. This plan will help guide and coordinate mitigation activities throughout the planning area. The plan was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to use federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Las Animas County's hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the county, and puts all partners on the same planning cycle for future updates.
- Meet the planning requirements of FEMA's Community Rating System (CRS), allowing planning partners that participate in the CRS program to maintain or enhance their CRS classifications.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All citizens and businesses of Las Animas County are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the county. It provides a viable planning framework for all foreseeable natural hazards that may impact the county. Participation in development of the plan by key stakeholders in the county helps ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide, and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 ELEMENTS OF THIS PLAN

This plan includes all federally required elements of a disaster mitigation plan:

Countywide elements:

- – A description of the planning process
- – The public involvement strategy
- – A list of goals and objectives
- – A countywide hazard risk assessment
- – Countywide mitigation actions
- – A plan maintenance strategy

Jurisdiction-specific elements for each participating jurisdiction:

- – A description of the participation requirements established by the Steering Committee
- – Jurisdiction-specific mitigation actions

The following appendices include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions
- Appendix B—The FEMA Local Mitigation Plan Review Tool
- Appendix C—Public outreach information, including the hazard mitigation questionnaire and summary and documentation of public meetings
- Appendix D—A menu of mitigation alternatives reviewed for this plan
- Appendix E—Worksheets for each recommended mitigation action
- Appendix F—Plan adoption resolutions from planning partners
- Appendix G—A template for progress reports to be completed as this plan is implemented

All participating communities will adopt the plan in its entirety.

1.4 LOCAL MITIGATION PLAN REVIEW TOOL

The Local Mitigation Plan Review Tool demonstrates how the Local Mitigation Plan meets the regulation in Title 44 of the Code of Federal Regulations (44 CFR) Section (§) 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-Jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each element of the plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference the *Local Mitigation Plan Review Guide* when completing the Local Mitigation Plan Review Tool. The Local Mitigation Plan Review Tool is included in this hazard mitigation plan as Appendix B.

CHAPTER 2.
PLAN METHODOLOGY

2.1 GRANT FUNDING

Las Animas County applied for a grant through FEMA's Hazard Mitigation Grant Program (HMGP) to supplement the plan development process. The Las Animas County Office of Emergency Management (OEM) was the applicant agent for the grant. Grant funding was appropriated in 2015. It covered 75% of the cost for development of this plan; 12.5% of the funding was provided by the Colorado Division of Homeland Security and Emergency Management (DHSEM), and the remaining 12.5% through local match. Las Animas County hired Tetra Tech to assist with development and implementation of the plan. The Tetra Tech Project Manager assumed the role of the lead planner, reporting directly to a county-designated project manager, previously Emergency Manager Ms. Kim Chavez.

2.2 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Las Animas County opened this planning effort to all eligible local governments in the county. The planning partners covered under this plan are shown in Table 2-1.

TABLE 2-1.
COUNTY AND PLANNING PARTNERS

Jurisdiction	Point of Contact	Title
Las Animas County	Kim Chavez	Emergency Manager
City of Trinidad	Tim Howard	Fire Chief
Town of Aguilar	Tyra Avila	Town Clerk
Town of Cokedale	Kathy Kumm	Town Clerk
Stonewall Fire Protection District	Loyd Holliman	Fire Chief

Each jurisdiction wishing to join the planning partnership was asked to commit to the process and have a clear understanding of expectations. These include:

- Each partner will support and participate in the meetings of the Steering Committee overseeing the development of the plan. Support includes allowing this body to make decisions regarding plan development and scope on behalf of the partnership.
- Each partner will provide support as needed for the public involvement strategy developed by the Steering Committee in the form of mailing lists, possible meeting space, and media outreach such as newsletters, newspapers or direct-mailed brochures.
- Each partner will participate in plan development activities such as:
  - Steering Committee meetings
  - Public meetings or open houses
  - Workshops and planning partner training sessions
  - Public review and comment periods prior to adoption

  Attendance will be tracked at such activities, and attendance records will be used to track and document participation for each planning partner. All participating communities are expected to attend and actively participate in all meetings.

- Each partner will be expected to review the risk assessment and identify hazards and vulnerabilities specific to its jurisdiction. Contract resources will provide jurisdiction-specific mapping and technical consultation to aid in this task, but the determination of risk and vulnerability ranking will be up to each partner.
- Each partner will be expected to review the mitigation recommendations chosen for the overall county and evaluate whether they will meet the needs of its jurisdiction. Projects within each jurisdiction consistent with the overall plan recommendations will need to be identified, prioritized, and reviewed to identify their benefits and costs.
- Each partner will sponsor at least one public meeting to present the draft plan at least two weeks prior to adoption.
- Each partner will be required to formally adopt the plan.
- Each partner agrees to the plan implementation and maintenance protocol.

Failure to meet these criteria may result in a partner being dropped from the partnership by the Steering Committee, and thus losing eligibility under the scope of this plan.

2.3 DEFINING THE PLANNING AREA

The planning area was defined to consist of all of Las Animas County. All partners to this plan have jurisdictional authority within this planning area. The planning area and partners are shown on Figure 1-1.

2.4 THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A Steering Committee was formed to oversee all phases of the plan. The members of this committee included key planning partner staff, citizens, and other stakeholders from within the planning area. Table 2-2 lists the committee members.

TABLE 2-2.
STEERING COMMITTEE MEMBERS

Name	Jurisdiction/Title
Kim Chavez	Las Animas County/Emergency Manager
Jodi Amato	Las Animas County/Assessor
Paula Lucero	Las Animas County/Assistant OEM
Derek Navarette	Las Animas County/Undersheriff
Phil Dorenkamp	Las Animas County/Road and Bridge Supervisor
Shawn Bazanele	Las Animas County/Chief Deputy Clerk and Recorder
Patricia “Peach” Vigil	Las Animas County/Clerk and Recorder
Robert Bukovac	Las Animas-Huerfano Counties District Health Department/Emergency Preparedness and Response Coordinator
Kimberly Gonzales	Las Animas-Huerfano Counties District Health Department/Interim Director
Cathy Montera	Las Animas-Huerfano Counties District Health Department/Registered Nurse
Margaret Maria	Las Animas County/Coroner
Dominic Verquer	Las Animas County/Coroner
Audra Garrett	City of Trinidad/Assistant City Manager

**TABLE 2-2.
STEERING COMMITTEE MEMBERS**

Name	Jurisdiction/Title
Tim Howard	City of Trinidad/Fire Chief
Charles Glorioso	City of Trinidad/Police Chief
Rita Mantelli	City of Trinidad/Communication Director
Mike Valentine	City of Trinidad/Utilities Superintendent
Linda Vigil	City of Trinidad/Utilities Department Assistant
Garrett Bendez	City of Trinidad/Fireman
Miguel Ortiz	City of Trinidad/Fireman
Anthony Trammell	City of Trinidad/Fireman
Daniel Bates	Trinidad Ambulance District/Assistant EMS Chief
Tyra Arila	Town of Aguilar/Clerk
Kathy Kumm	Town of Cokedale/Clerk
Lloyd Holliman	Stonewall Fire Protection District/Fire Chief
MaryAnn Herzog	Bon Carbo Fire Protection District/Fire Chief
Tom Lane	Spanish Peaks Bon Carbo Fire Protection District/
Dave Bacharach	Hoehne Fire Protection District/Fire Chief
James McCune	Purgatoire River Volunteer Fire Department/representative
Sherri Bacharach	Mt. San Rafael Hospital/ER Director
CK Morey	Las Animas Fire Chiefs Association/representative
Patricia Gavelda	Colorado Division of Homeland Security and Emergency Management

The Steering Committee agreed to meet a minimum of three times or as needed throughout the course of the plan's development. The consultant and Las Animas County Emergency Manager facilitated three Steering Committee meetings, which addressed a set of objectives based on the work plan established for the plan. Meeting agendas, notes, and attendance logs can be found in Appendix C of this document. All Steering Committee meetings were open to the public and notices of the meetings were posted to the county website and released to the press.

The planning team made a presentation at a Steering Committee meeting on October 20, 2015, to introduce the mitigation planning process. The Steering Committee, planning partners and public all were encouraged to participate in the plan update process. Key meeting objectives were as follows:

- Steering Committee purposes and responsibilities
- Plan partners and signators and responsibilities
- Provide an overview of DMA
- Describe the reasons for a plan
- Discuss community participation and the survey
- Develop plan mitigation goals and objectives
- Describe hazard analysis
- Discuss critical facilities

The Steering Committee met on March 30, 2016, to review the hazard risk assessment for Las Animas County and the results of the community survey. Based on the risk assessment and survey results, the Steering Committee then ranked the natural hazards. The hazards were ranked based on their probability of occurrence and their potential impact on people, property, and the economy. The results of the hazard ranking is discussed in Chapter 18.

The third Steering Committee meeting was held on June 22, 2016. The main objective of the meeting was to present and rank mitigation actions, which were developed to address hazards ranked "medium" or "high." The mitigation actions are discussed in Chapter 19. During the meeting information was provided on how the plan would be maintained and the consultant presented a fact sheet on Hazard Mitigation Assistance grants.

2.5 COORDINATION WITH OTHER AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - Colorado Division of Homeland Security and Emergency Management
  - U.S. Forest Service
  - Colorado State Forest Service
  - Colorado Division of Water Resources (Dam Safety Branch)
  - Branson Fire Protection District
  - Fishers Peak Fire Protection District
  - Hoehne Fire Protection District
  - Kim Fire Protection District
  - Spanish Peaks Bon Carbo Fire Protection District
  - Mt. San Rafael Hospital
  - Trinidad Ambulance District

  These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process and supported the effort by attending meetings or providing feedback on issues.
- **Pre-Adoption Review**—The agencies listed above were provided an opportunity to review and comment on this plan, primarily through the county's website and during the Steering Committee meetings. Each agency was sent an email message informing them that draft portions of the plan were available for review. In addition, the Colorado DHSEM reviewed and commented on this plan for a pre-adoption review to ensure program compliance.

2.6 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). Chapter 5.9 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives. In addition, the following programs can affect mitigation within the planning area:

- Las Animas County Comprehensive Land Use Plan
- Several communities within Las Animas County have independent Community Wildfire Protection Plans (CWPP) such as the Stonewall Fire CWPP, the Santa Fe Trail Estate CWPP, and Sprit Mountain Ranch CWPP.
- Comprehensive Plans, Zoning Regulations, and Municipal Codes for the participating communities of Trinidad, Aguilar, and Cokedale.

An assessment of all planning partners' regulatory, technical, and financial capabilities to implement hazard mitigation initiatives is presented in Chapter 6. Many of these relevant plans, studies, and regulations are cited in the capability assessment. The review of existing programs and the assessment of capabilities identify the plans, regulations, personnel, and funding mechanisms available to the county and planning partners to impact and mitigate the effects of natural hazards. The review also helps identify opportunities for the planning partners to strengthen and expand their abilities to proactively mitigate natural hazards in the community through the expansion of existing departments and programs; completion of applicable plans; adoption of necessary regulations or ordinances; creation and hiring of new departments and staff; or mutual aid agreements and memorandums of understanding with neighboring communities. The planning partners reviewed the findings of the capabilities assessment during the second Steering Committee meeting and used this information to identify mitigation actions.

2.7 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The CRS expands on these requirements by making CRS credits available for optional public involvement activities. The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee
- Use a community survey/questionnaire to evaluate whether the public's perception of risk and support of hazard mitigation has changed since the initial planning process
- Attempt to reach as many planning area citizens as possible using multiple media
- Identify and involve planning area stakeholders
- Solicit public feedback at each state of plan implementation, monitoring, and evaluation

2.7.1 Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies, and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including planning partners. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders were encouraged to attend and participate in all committee meetings.

2.7.2 Survey/Questionnaire

A hazard mitigation plan questionnaire (see Figure 2-1) was developed to gauge household preparedness for natural hazards; the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards; and the perceived impact of natural hazards on Las Animas County residents and businesses. This questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to its 35 questions helped guide the Steering Committee in prioritizing hazards of impact and in selecting goals, objectives, and mitigation strategies. A total of 87 questionnaires were completed during the course of this planning process. The complete questionnaire and a summary of its findings can be found in Appendix C.

Las Animas County CO HMP Update Survey

1. Survey Introduction

A partnership of the county government and other stakeholders in Las Animas County are working together to create a Hazard Mitigation Plan. This plan will focus only on natural hazards identified within Las Animas County. The plan is developed in response to Federal programs that enable the county to use pre- and post-disaster financial assistance to reduce the exposure of county residents to risks associated with hazards.

In order to plan for future natural disasters, we need your assistance. This questionnaire is designed to help us gauge the level of knowledge local citizens already have about disaster issues and to identify areas vulnerable to various types of disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of 34 questions plus an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous. When you have finished the survey, please click "Done" on the final page.

The Las Animas County Hazard Mitigation Steering Committee thanks you for taking the time to participate in this information-gathering process.

Figure 2-1. Sample Page from Questionnaire Distributed to the Public

2.7.3 Meetings

Three Steering Committee meetings were held during the planning process. Meetings were held on October 20, 2015, March 30, 2016, and June 22, 2016, in the City of Trinidad (Figure 2-2). The draft plan was then presented and reviewed before the Las Animas County Board of County Commissioners (BOCC) on XXX XX, 2016. The meeting allowed attendees to review handouts, maps and other resources and have direct conversations with project staff. Reasons for planning and information generated for the risk assessment were shared with attendees via a PowerPoint presentation. Planning partners and the planning team were present to answer questions.

Figure 2-2. Steering Committee Meeting October 20, 2015

2.7.4 Press Releases/News Articles

Press releases were distributed over the course of the plan's development as key milestones were achieved and prior to each public meeting. The planning effort received press coverage as shown in Figure 2-3.

Figure 2-3. Planning Process Press Coverage

2.7.5 Internet

At the beginning of the plan development process, the county posted information regarding the update process, a link to the community survey and a link to the mitigation plan on the Las Animas County website (Figure 2-4). The county website was used to keep the public posted on plan development milestones and to solicit relevant input. Information on the plan development process, the Steering Committee, the questionnaire, and phased drafts of the plan were made available to the public on the site throughout the process. The county intends to keep a link on the website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

Figure 2-4. Sample Page from the Las Animas County Website

2.8 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table 2-3 summarizes important milestones in the development of the plan.

**TABLE 2-3.
PLAN DEVELOPMENT MILESTONES**

Date	Event	Description	Attendance
2015			
5/20	Contract signed	Notice to proceed given to Tetra Tech	N/A
10/20	Steering Committee/ Stakeholder Meeting #1	Presentation on plan process given, participation, review of goals and objectives, etc.	Las Animas County, Trinidad, Aguilar, Cokedale, Stonewall FPD
2016			
3/30	Steering Committee Meeting #2	Review community survey, review of hazard risk assessment, review and update plan goals and objectives	Las Animas County, Trinidad, Aguilar, Cokedale, Stonewall FPD
6/22	Steering Committee Meeting #3	Mitigation actions presentation and project development	Las Animas County, Trinidad, Aguilar, Cokedale, Stonewall FPD
Ongoing	Public Outreach	News articles and website posting	N/A
X/X	Draft Plan	Internal review draft provided to Steering Committee	N/A

X/X	Public Comment Period	Initial public comment period of draft plan opens. Draft plan posted on plan website with press release notifying public of plan availability	N/A
X/X	Plan Review	Final draft plan submitted to Colorado Division of Homeland Security and Emergency Management for review	N/A
X/X	Plan Approval Pending Adoption	Final draft plan submitted to FEMA for approval pending adoption	N/A
X/X	Public Outreach	Final public meeting on draft plan	N/A
X/X	Adoption	Adoption window of final plan opens	N/A
X/X	Plan Approval	Final plan approved by FEMA	N/A

Notes:

FEMA Federal Emergency Management Agency
FPD Fire Protection District
N/A Not applicable

CHAPTER 3.
GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee established a guiding principle, a set of goals, and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, objectives, and mitigation actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Mitigation actions were prioritized based on the action meeting multiple objectives.

3.1 GUIDING PRINCIPLES

A guiding principle is an overarching goal that focuses the range of objectives and actions to be considered. The guiding principle is not a goal because it does not describe a hazard mitigation outcome and it is broader than a hazard-specific objective. The guiding principle for this hazard mitigation plan is to:

Identify hazards and assess risks from natural hazards in Las Animas County.

3.2 GOALS

The following are the mitigation goals for this plan:

- **Goal 1:** Protection of people, property, and natural resources.
- **Goal 2:** Increase awareness of natural hazards and their mitigation.
- **Goal 3:** Coordinate and integrate hazard mitigation activities.

3.3 OBJECTIVES

The objectives are used to help establish priorities and support the agreed upon goals. The objectives are as follows:

Objectives in support of Goal 1:

- **Objective 1.1:** Develop projects focused on preventing loss of life and injuries from natural hazards
- **Objective 1.2:** Identify and prioritize actions to protect critical, essential, and necessary assets, infrastructure, and cultural resources
- **Objective 1.3:** Protect and enhance natural resources
- **Objective 1.4:** Identify and expand emergency services protocols for people who are at high risk from hazard events, such as the homeless, elderly, disabled, and oxygen-dependent people

Objectives in support of Goal 2:

- **Objective 2.1:** Continue to develop and expand public awareness and information programs
- **Objective 2.2:** Expand public awareness of flood and flash flood hazards in general and at specific high-risk locations
- **Objective 2.3:** Expand public awareness of wildfire hazards and measures by which people can protect themselves, their property, and their community

- **Objective 2.4:** Educate elected officials, agency administrators, and business owners on mitigation strategies and best practices

Objectives in support of Goal 3:

- **Objective 3.1:** Strengthen connections between hazard mitigation activities; and preparedness, response, and recovery activities
- **Objective 3.2:** Identify existing local government monitoring and decision-making tools; identify gaps and needed improvements
- **Objective 3.3**: Strengthen collaboration with neighboring communities, non-governmental agencies, and businesses to improve hazard response capabilities and resources
- **Objective 3.4**: Develop systems to identify hazard-prone areas and affected populations and track people and resources before and during a natural hazard event

CHAPTER 4.
IDENTIFIED HAZARDS OF CONCERN AND RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- Hazard identification—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- Vulnerability identification—Determine the impact of natural hazard events on the people, property, environment, economy, and lands of the region.
- Cost evaluation—Estimate the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation plan evaluates the risk of natural hazards prevalent in the planning area and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)).

4.1 IDENTIFIED HAZARDS OF CONCERN

For this plan, the Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Based on the review, this plan addresses the following hazards of concern:

- Avalanche
- Dam/Levee Failure
- Drought
- Earthquake
- Erosion and Deposition
- Expansive Soil
- Extreme Heat
- Flood
- Hail
- Landslide, Mud/Debris Flow, Rockfall
- Lightning
- Severe Wind
- Subsidence
- Tornado
- Wildfire
- Winter Storm

Several of these hazards were profiled together because of their common occurrence or damage assessments, such as drought and extreme heat, and hail, lightning, and severe winds.

4.2 CLIMATE CHANGE

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. "Climate change" refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase.
- More extreme precipitation is likely, increasing the risk of flooding.
- The world's average temperature is expected to increase.

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding, and wildfires; and more heat-related stress. In many cases, communities are already facing these problems to some degree. Climate change influences the frequency, intensity, extent, or magnitude of the problems.

This hazard mitigation plan addresses climate change as a secondary impact for each identified hazard of concern. Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are being developed to assess the potential impacts of climate change, none are currently available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

4.3 METHODOLOGY

The risk assessments in Chapter 7 through Chapter 17 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

Identify and profile each hazard – The following information is given for each hazard:

- Geographic areas most affected by the hazard
- Event frequency estimates
- Severity estimates
- Warning time likely to be available for response

Determine exposure to each hazard – Exposure was evaluated by overlaying hazard maps, when available, with an inventory of structures, facilities, and systems to identify which of them would be exposed to each hazard. When hazard mapping was not available, a more qualitative discussion of exposure is presented.

Assess the vulnerability of exposed facilities – Vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as geographic information system (GIS) and FEMA's hazard modeling program called Hazards, United States-Multi Hazard (HAZUS-MH) were used to perform this assessment for the flood, dam failure, and earthquake hazards. Outputs similar to those from HAZUS were generated for other hazards, using maps generated by the HAZUS program.

4.4 RISK ASSESSMENT TOOLS

4.4.1 HAZUS-MH—Dam Failure, Earthquake, and Flood

Overview

In 1997, FEMA developed the standardized Hazards U.S., or HAZUS, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. HAZUS was later expanded into a multi-hazard methodology, HAZUS-MH, with new models for estimating potential losses from hurricanes and floods.

HAZUS-MH is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation, and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

HAZUS-MH provides default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1** – All of the information needed to produce an estimate of losses is included in the software’s default data. These data are derived from national databases and describe in general terms the characteristic parameters of the planning area.
- **Level 2** – More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics, and building inventory, as well as data for utilities and critical facilities. This information is needed in a GIS format.
- **Level 3** – This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood** – A Level 2, general building stock analysis, was performed. GIS building and assessor data (replacement cost values and detailed structure information) were loaded into HAZUS-MH. An updated inventory was used in place of the HAZUS-MH defaults for essential facilities, transportation, and utilities. The Las Animas County floodplains were delineated using HAZUS 2.2 hydraulics and hydrology modeling to identify the hazard areas and estimate potential losses from the 100-year flood event and a 500-year flood event.

  Note: Flood maps for Las Animas County are available through the Las Animas County Planning and Land Use Department.

- **Dam Failure** – Dam failure inundation mapping for the planning area was provided by Colorado Department of Water Resources. The mapping was not in a format that could be used by HAZUS, but HAZUS was used to determine cost estimate losses and damage to buildings in the inundation areas.
- **Earthquake** – A Level 2 analysis was performed to assess earthquake risk and exposure. The arbitrary event and probabilistic options in the HAZUS earthquake module were used for the analysis of this hazard. The arbitrary events were chosen based on the Colorado Geological Survey's 2005 statewide earthquake analysis using HAZUS. An updated general building stock inventory was developed using replacement cost values and detailed structure information from assessor tables. An updated inventory of essential facilities, transportation and utility features was used in place of the HAZUS-MH defaults. Two scenario events and one probabilistic event were modeled:
  - A scenario event with a Magnitude-7.5 event on the North Sangre de Cristo Fault.
  - A scenario event with a Magnitude 7.0 event on the Cheraw Fault.
  - The standard HAZUS analysis for a 500-Year Probabilistic Event.

4.4.2 Other Hazards of Concern

For hazards of concern that are not directly modeled in HAZUS, future losses could not be estimated. However, HAZUS-MH is able to map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. Locally-relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others. The primary data source was the Las Animas County GIS database and National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information, augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

- **Avalanche** – Data provided by Colorado Avalanche Information Center (CAIC)
- **Drought** – National Drought Mitigation Center
- **Erosion and Deposition, Expansive Soil, and Subsidence** – Datasets from the Colorado Geological Society regarding evaporite-bearing bedrock and known coal mining hazard areas
- **Extreme Heat**– Western Regional Climate Center
- **Hail, Lightning, Tornado, Severe Wind, and Winter Storm –** Data provided by NOAA National Centers for Environmental Information
- **Landslide, Mud/Debris Flow, and Rockfall** – Datasets of mapped landslides at various scales provided by the Colorado Geological Survey's Landslide Inventory Program

- **Wildfire** – Information on wildfire hazards areas was provided by the Colorado State Forest Service's Colorado Wildfire Risk Assessment Portal (CO-WRAP)

4.4.3 Limitations

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk. Over the long term, Las Animas County and its planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

CHAPTER 5.
LAS ANIMAS COUNTY PROFILE

Las Animas County covers approximately 4,773 square miles at the southeastern border of Colorado and New Mexico (see Figure 5-1). It is the largest county by area in Colorado. The average elevation of Las Animas County is 6,200 feet above mean sea level. There are six incorporated municipalities in Las Animas County: Aguilar, Branson, Cokedale, Kim, Starkville, and Trinidad. Trinidad is the largest city in the county and is the county seat. The City of Trinidad is located along Interstate 25 (I-25) at the foot of Fisher's Peak along the Purgatoire River. The Towns of Branson and Kim are located on the plains of eastern Las Animas County. The Town of Aguilar is situated in the Apishapa River Valley in the northern portion of the county. The Town of Cokedale is located west of Trinidad along State Highway 12 and the Town of Starkville is south of Trinidad along I-25. (Figure 5-1).

The county is the 33rd most populous of Colorado's 64 counties, with a 2014 population of 14,789. The county is served by I-25, U.S. Highways 350 and 160, and State Highway 12. Airports include Perry Stokes Airport, Pinon Canyon Airport, Jecan Airport, Wine Glass International Airport, and the Tercio Rand Airstrip. Trinidad is serviced by Amtrak Railroad. There is one hospital in the county, the 25-bed Mount San Rafael Hospital in Trinidad.

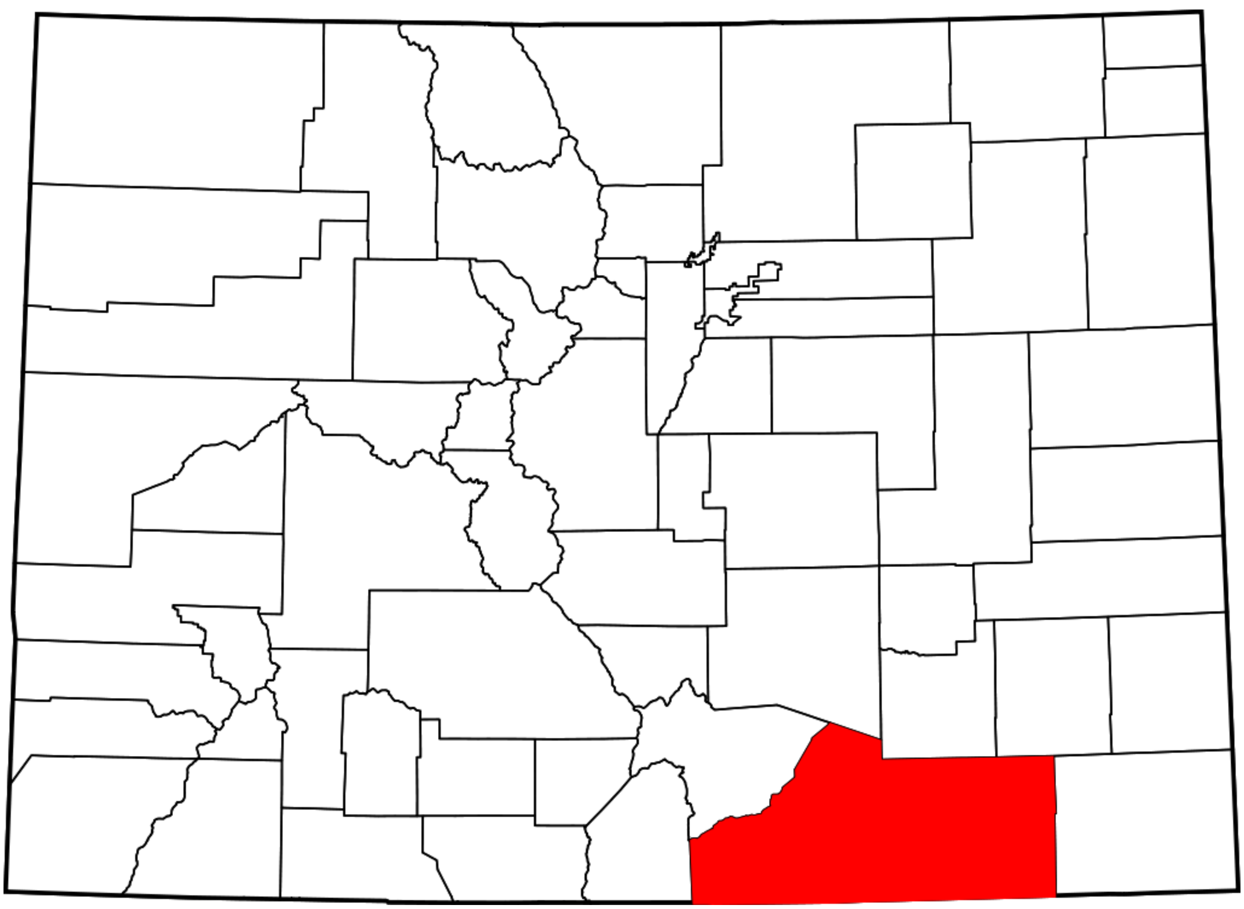


Figure 5-1. Location of the Las Animas County Planning Area within the State of Colorado

The mostly rural county still relies heavily on farming and ranching as its main economic engine. About 75 percent of the county is rangeland or graze woodlands used for cattle production. Alfalfa is the primary crop.

Coal, natural gas, sand, gravel deposits, and wildlife are other natural resources in the country. Methane gas production and development is found in the Raton Formation primarily in the foothills west of I-25. It is a major contributor to the economy of Las Animas County. Areas of sand and gravel deposits are found on fan remnants bordering the foothills. The principal game animals include bear, elk, mule deer, turkey, mountain lion, and Rocky Mountain bighorn sheep.

Protected areas of the county are the Comanche National Grassland, San Isabel National Forest, Spanish Peaks Wilderness Area, and Trinidad Lake State Park. The Raton Pass National Historic Landmark, the Santa Fe Trail Scenic and Historic Byway, Highway of Legends Scenic Byway and other areas make up only some of the trails and landmarks of the county.

5.1 HISTORICAL OVERVIEW

According to the Trinidad and Las Animas County Chamber of Commerce, Las Animas County was founded in 1866. Long before people came to this area, millions of years before even the Sangre de Cristo Mountains developed, dinosaurs roamed the tropical forests that once flourished here. They left behind the longest set of dinosaur tracks in North America. There are over 1,300 footprints along the Purgatoire River.

Las Animas County takes its name from the Rio de las Animas Perdidas En Purgatorio, which means "River of the Lost Souls." Legend has it that a group of Spanish explorers heading home to Mexico were attacked by Indians. Because there was no priest with them to administer last rites, their souls were lost in Purgatory, thus the name given to the county as well as the Purgatoire River. The community's rich history was molded by the Spanish and French explorers, scouts, trappers and traders who left evidence of their passing by colorful geographic names.

The county seat, Trinidad, was considered to be the state capital prior to Denver being selected. Trinidad is the home of many firsts including the first state school district. The wealth of the City of Trinidad is evident in the sandstone and brick buildings, both downtown and in residences. Many of the late 1880-era churches, the Carnegie Public Library, and City Hall were constructed of locally quarried stone. The City of Trinidad downtown area has been designated as a National Historic District and is known as El Corazon de Trinidad.

Trinidad's history boasts visits from Wyatt Earp and Doc Holliday on their infamous Vendetta Ride just ahead of Arizona authorities, and their ally and friend Bat Masterson, who was Marshal in Trinidad in the 1880s. Wyatt Earp also drove the stage coach between Trinidad and Box Springs, New Mexico. Billy the Kid was also noted in the area. Recreation and culture were centered in the Jaffa Opera House, built in 1888; the West Theater (now the Fox), built in 1908, with a large ballroom, and three floors of seating; Central Park's outdoor dance pavilion, amusement park and boating area; and Kit Carson Park, dedicated in 1910, which includes a bandstand, Santa Fe Trail Marker, and a statue.

In the early 1900s, many of the towns and communities in the county were founded as supply, stage coach and railroad stops, and coal camps, with mining driving change in the area. European, Eastern, and Middle Eastern immigrants all came to mine the coal-rich areas. The Town of Cokedale, known in 1907 as a model coal camp, remains much as it was then. The mining industry supported the railroad and the regional steel mills of the day.

The first junior college in the state, Trinidad State College, (now Trinidad State Junior College) opened in 1925 with an enrollment of 37 students.

5.2 MAJOR PAST HAZARD EVENTS

Federal disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A federal disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Some of the programs are matched by state programs. The planning area has experienced 11 events since 1965 for which federal disaster declarations were issued. These events are listed in Table 5-1.

Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern. More detailed event tables can be found in the individual hazard profile sections.

TABLE 5-1.
PAST FEDERAL DISASTER DECLARATIONS IN LAS ANIMAS COUNTY

Disaster Declaration[a]	Incident Type	Description	Incident Dates
DR-200	Tornado	Tornadoes, Severe Storms, & Flooding	6/19/1965
EM-3025	Drought	Drought	1/29/1977
DR-1276	Severe Storms	Flooding	4/29 – 5/19/1999
FS-2413	Fire	James John/Fisher Fire	6/2 – 6/26/2002
FS-2412	Fire	Spring Fire	6/2 – 6/26/2002
DR-1421	Fire	Wildfires	4/23 – 8/6/2002
EM-3185	Snow	Snow	3/17 – 3/20/2003
EM-3224	Coastal Storm	Hurricane Katrina Evacuation	8/29 – 10/1/2005
FM-2613	Fire	Mauricio Canyon Fire	1/7 – 1/16/2006
EM-3270	Snow	Snow	12/18 – 12/22/2006
EM-3271	Snow	Snow	12/28 – 12/31/2006

a. Federal disaster declarations are coded as follows: DR = Major Disaster Declaration; EM = Emergency Declaration; FM = Fire Management Assistance, FS = Fire Suppression Authorization

Source: FEMA Disaster Declarations Summary - Open Government Dataset (http://www.fema.gov/media-library/assets/documents/28318?id=6292)

U.S. Department of Agriculture's (USDA) Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans (EM) to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM eligibility, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs, have historically used disaster designations as an eligibility requirement trigger.

Table 5-2 provides the USDA Secretarial disaster declarations that included Las Animas County from the recent years of 2003 through 2015. These include declarations in Las Animas County and when the county is contiguous to a designated county. Prior years of historic disaster declarations can be requested from USDA.

TABLE 5-2.
USDA SECRETARIAL DISASTERS (2003-2015)

Year	Type	Declaration Number[a]
2003	Drought, Insects	S1843
2005	Drought	S2031
2005-2006	Drought, Crop Diseases, Insects	S2287
2005-2006	Drought, Fire, High Winds, Heat	S2327
2008	Drought	S2750
2009	Drought	S2996
2011	Drought	S3125, S3133, S3144
2012	Drought, Wind/High Winds, Heat/Excessive Heat	S3260
2012	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insects	S3282
2013	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insects	S3456, S3461, S3518
2014	Drought, High Winds, Wildfire, Heat, Insects	S3627, S3630
2014	Hail	S3764
2015	Drought, High Winds, Wildfire, Heat, Insects	S3785, S3788

a. Secretarial Disaster Number

Source: U.S. Department of Agriculture, (http://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index)

5.3 CLIMATE

Las Animas County has a high elevation, low humidity, southern climate that fluctuates seasonally due to its varied topography. Weather extremes are usually scattered and of short duration. Summers are generally warm and dry. The majority of snowfall occurs during December, January, and March and usually melts within a couple days.

The City of Trinidad gets 15 inches of rain per year, less than half of the national average rainfall of 37 inches per year. Snowfall average is approximately 28 inches. Typically, Trinidad has 72 days per year of any measurable precipitation and, on average, there are 265 sunny days per year.

The Western Regional Climate Center reports data from the Trinidad weather station in Las Animas County. Table 5-3 contains temperature summaries for the station. Figure 5-2 graphs the daily temperature averages and extremes.

TABLE 5-3.
LAS ANIMAS COUNTY TEMPERATURE SUMMARIES TRINIDAD STATION

Period of record	7/1/1898 – 10/31/2012
Winter[a] Average Minimum Temperature	20.2°F
Winter[a] Mean Temperature	34.9ºF
Summer[a] Average Maximum Temperature	84.9°F
Summer[a] Mean Temperature	70.0ºF
Maximum Temperature	101°F; June 26, 1994
Minimum Temperature	-32°F; January 12, 1963
Average Annual # Days >90°F	24.1
Average Annual # Days <32°F	148.6

a. Winter: December, January, February; Summer: June, July, August
Source: Western Regional Climate Center, www.wrcc.dri.edu/

Source: Western Regional Climate Center, www.wrcc.dri.edu/

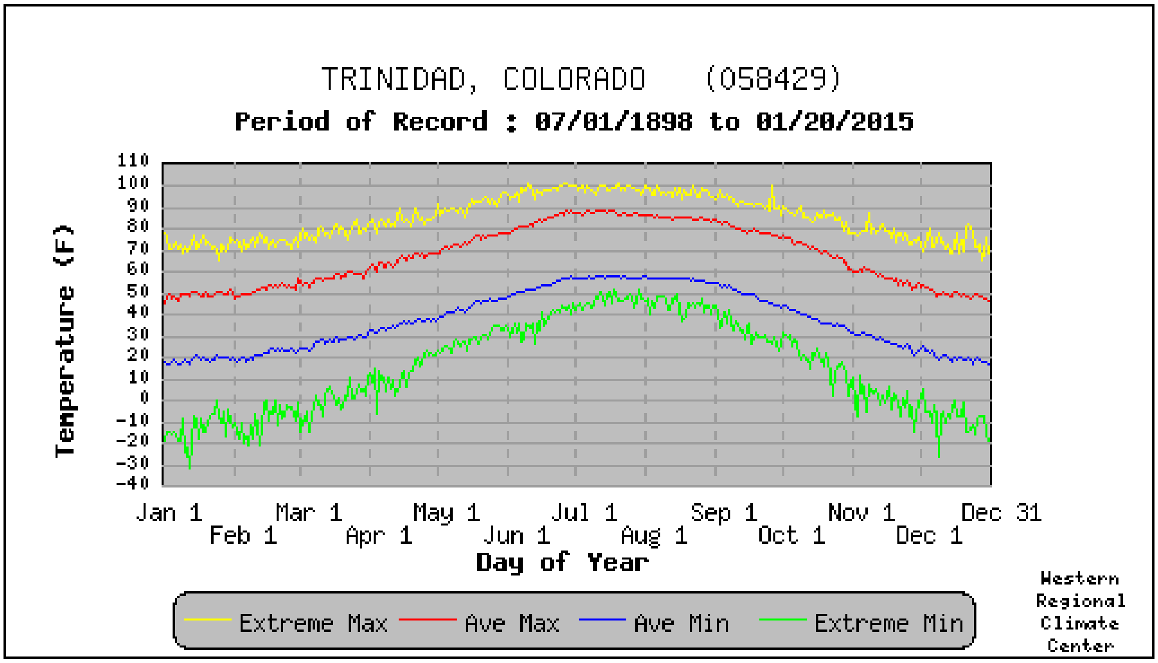


Figure 5-2. Trinidad Station Monthly Temperature Data (7/1/1898 – 1/20/2015)

Figure 5-3 and Figure 5-4 show the geographic distribution of average minimum and maximum temperatures in Las Animas County. The average first snowfall in the Trinidad area occurs in late October and the average final snowfall occurs in late April. While precipitation is normally highest in the months of May and July, in certain years the summer months can be very dry. Early fall tends to be temperate and dry. Figure 5-5 shows geographic distribution of annual average precipitation across the county. Based on lightning data from Vaisala's National Lightning Detection Network and calculations from the National Weather Service Office in Pueblo, 35.8 is the average number of cloud-to-ground lightning flashes per square mile from 1994 to 2014 in Las Animas County.

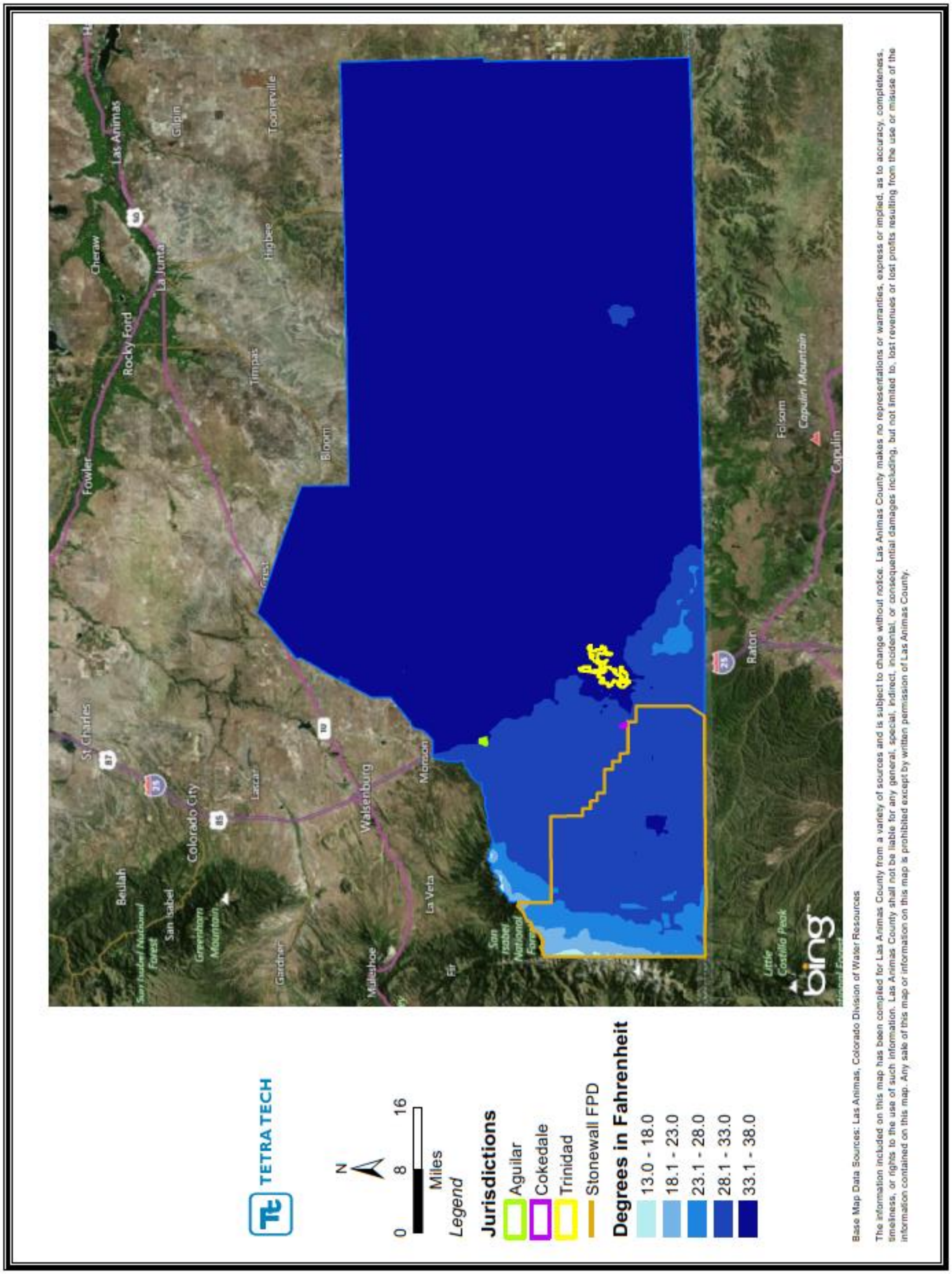


Figure 5-3. Annual Average Minimum Temperature (1981-2010)

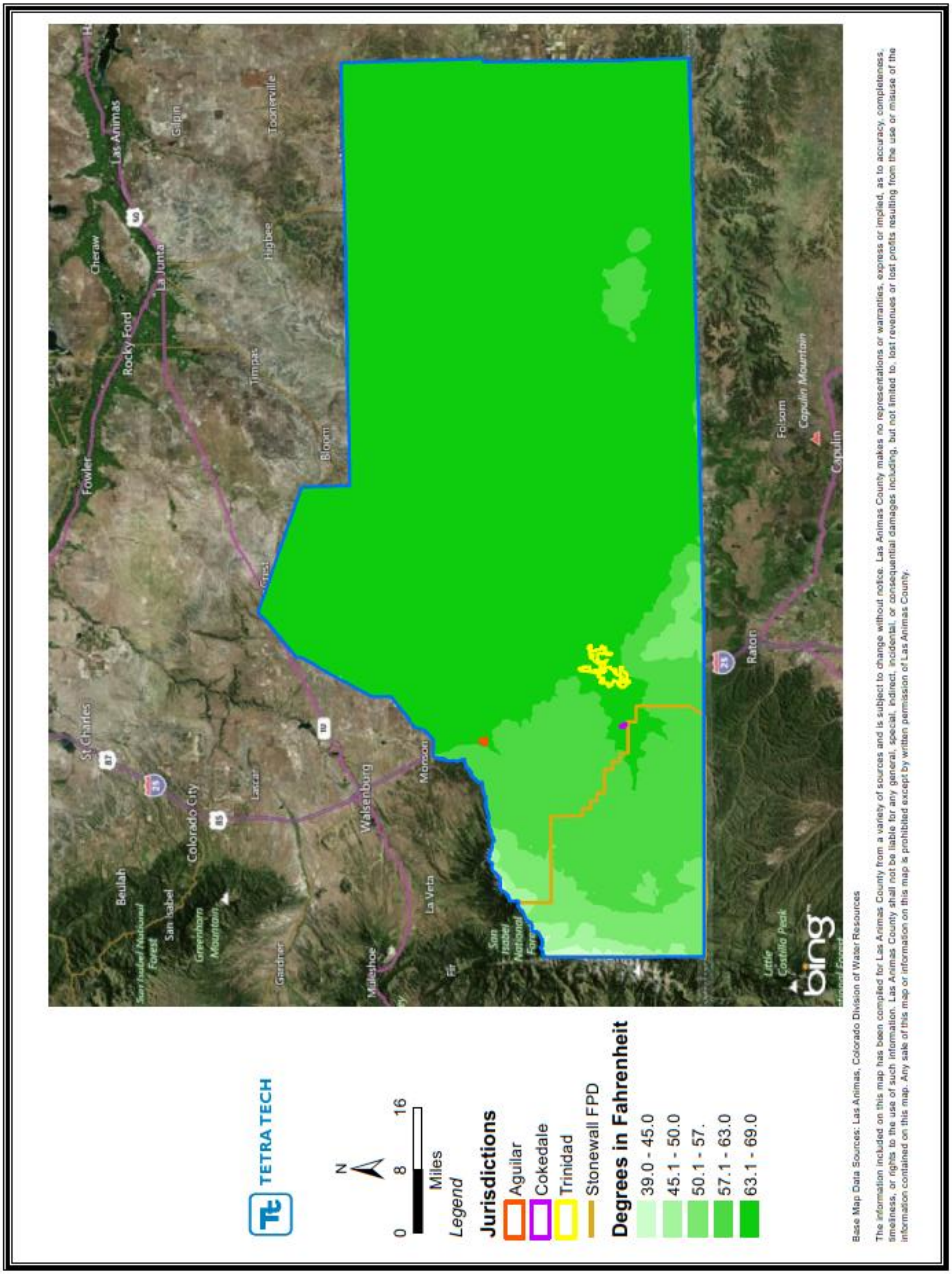


Figure 5-4. Annual Average Maximum Temperature (1981-2010)

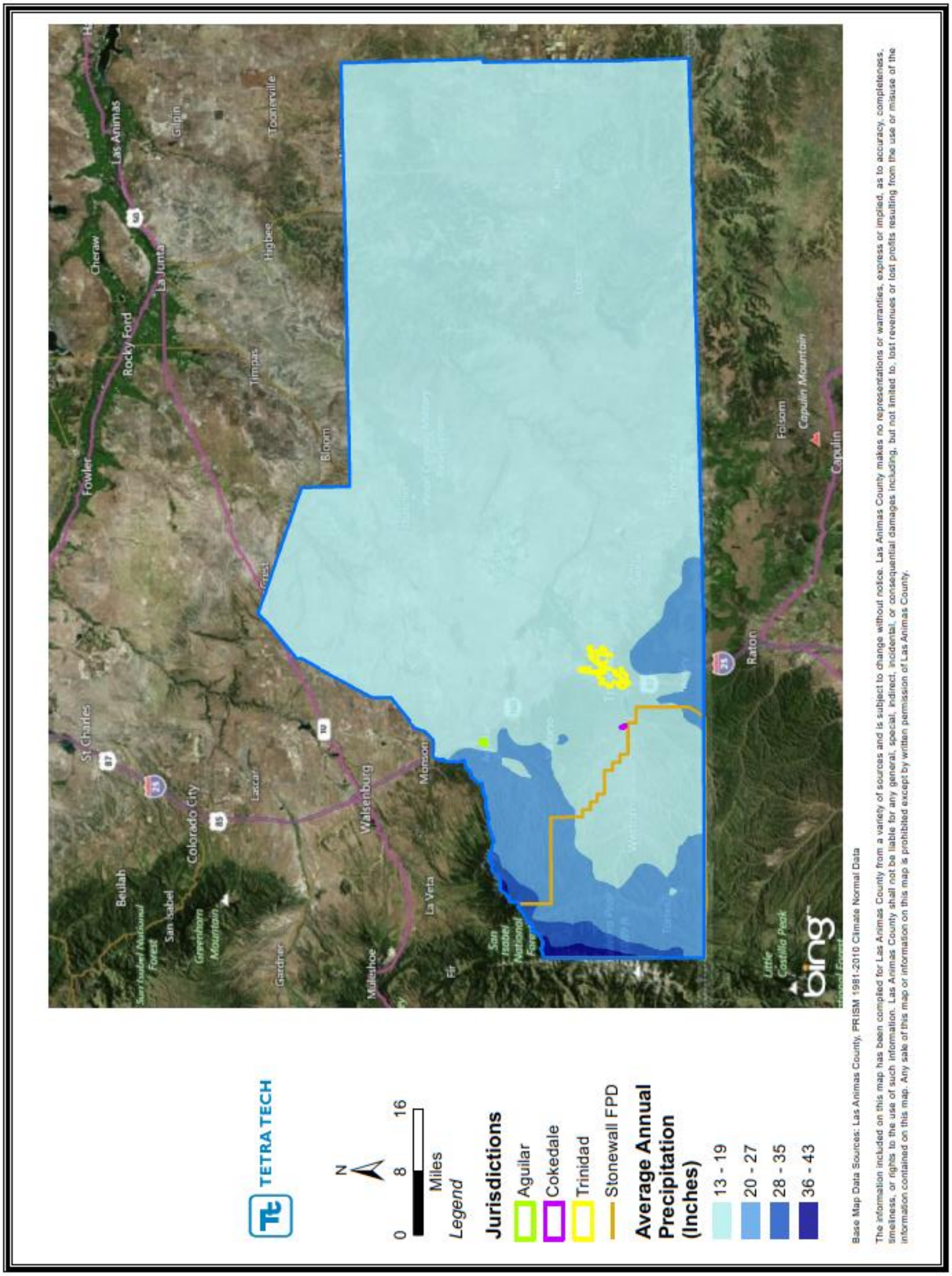


Figure 5-5. Annual Average Precipitation (1981-2010)

5.4 GEOLOGY AND SOILS

Las Animas County varies in elevation from approximately 4,400 feet to 13,500 feet near the top of the Sangre de Cristo Mountains. The Sangre de Cristo Mountains are located along the western border of Las Animas County. The county has the La Plata Mountains and wooded forests in the northeastern portion of the county, prairie and grassland in the center and west of the county, and Mesa Verde National Park to the south. The topography is divided into five physiographic provinces. The plains areas of the county are in the central high plains and the Upper Arkansas Valley rolling plains provinces. The basalt mesas along the southern border are in the Pecos-Canadian plains and valleys province. The western third of the county is in the southern Rocky Mountains and the southern Rocky Mountains foothills provinces.

The plains consist of broad, nearly level to gently rolling grasslands divided by steep canyons. They are bounded by the foothills to the west and by the basalt mesas to the south. Several large tributaries flow to the each and northeast through the plains. These include the Purgatoire and Apishapa Rivers, and the San Francisco, Frijole, Chacuaco, and Two Buttes Creeks.

The foothills province is an extensive plateau with steep hills, fans, and valleys west of I-25 to the base of the Sangre de Cristo Mountain range. Major tributaries dissecting the foothills are primarily the Purgatoire and Apishapa Rivers. The Longs, Lorencito, Sarcillo, and Wet Canyons drain into the Purgatoire River.

The rock and sandstone formations, including those near cliff dwellings in Mesa Verde National Park, are closely associated with the sandstone of Late Cretaceous age, which weathers to form deep alcoves. Ancient people farmed the thick, red loess (wind-blown dust) deposits on the mesa tops, which because of its particle size distribution has good moisture retention properties. The soil in this loess cover and the seasonal rains allowed these people to grow their crops (corn, beans, and squash) on the broad mesa tops. Today, geology is still an important concern in the Mesa Verde area because the landscape is susceptible to various forms of mass movement (landslides, debris flows, rockfalls), swelling soils, and flash floods that affect the park's archeological sites and its infrastructure (roads, septic systems, utilities, and building sites).

The county is also made of surficial deposits including: artificial fills, alluvium of small ephemeral streams, alluvium deposited by the Mancos River or Dolores River, residual gravel on high mesas, a combination of alluvial and colluvial deposits, fan deposits, colluvial deposits derived from the Menefee Formation, colluvial deposits derived from the Mancos Shale, rockfall deposits, debris flow deposits, earthflow deposits, translational and rotational landslide deposits, rock rubble deposits, and loess.

5.5 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. As defined for this hazard mitigation plan update, critical facilities include but are not limited to the following (as defined by the Colorado Water Conservation Board [CWCB]):

- Essential services facilities:
  - Public safety (police stations, fire and rescue stations, emergency vehicle and equipment storage, and, emergency operation centers)
  - Emergency medical (hospitals, ambulance service centers, urgent care centers having emergency treatment functions, and non-ambulatory surgical structures but excluding clinics, doctors' offices, and non-urgent care medical structures that do not provide these functions)
  - Designated emergency shelters
  - Communications (main hubs for telephone, broadcasting equipment for cable systems, satellite dish systems, cellular systems, television, radio, and other emergency warning systems, but excluding towers, poles, lines, cables, and conduits)

  - Public utility plant facilities for generation and distribution (hubs, treatment plants, substations and pumping stations for water, power and gas, but not including towers, poles, power lines, buried pipelines, transmission lines, distribution lines, and service lines)
  - Air transportation lifelines (airports [municipal and larger], helicopter pads and structures serving emergency functions, and associated infrastructure [aviation control towers, air traffic control centers, and emergency equipment aircraft hangars]).
- Hazardous materials facilities:
  - Chemical and pharmaceutical plants
  - Laboratories containing highly volatile, flammable, explosive, toxic, or water-reactive materials
  - Refineries
  - Hazardous waste storage and disposal sites
  - Aboveground gasoline or propane storage or sales centers.
- At-risk population facilities:
  - Elder care (nursing homes)
  - Congregate care serving 12 or more individuals (day care and assisted living)
  - Public and private schools (pre-schools, K-12 schools, before-school and after-school care serving 12 or more children)
- Facilities vital to restoring normal services:
  - Essential government operations (public records, courts, jails, building permitting and inspection services, community administration and management, maintenance and equipment centers)
  - Essential structures for public colleges and universities (dormitories, offices, and classrooms only).

Table 5-4 summarizes the general types of critical facilities and infrastructure in each municipality and unincorporated county areas. Figure 5-6 through Figure 5-12 show the location of critical facilities and critical utilities in the planning area. Since there are no critical utilities in the Town of Aguilar there is no map for the town. Due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. Critical facilities and infrastructure were analyzed in HAZUS to help rank risk and identify mitigation initiatives. The risk assessment for each hazard discusses critical facilities with regard to that hazard.

TABLE 5-4.
CRITICAL FACILITIES IN THE PLANNING AREA

Facility Type	Medical and Health	Protective Functions	Schools	Essential Government/ Other	**Total**
City of Trinidad	1	7	5	3	**16**
Town of Aguilar	0	1	2	2	**5**
Town of Cokedale	0	1	0	1	**2**
Stonewall FPD	0	6	2	0	**8**
Unincorporated	0	3	9	5	**17**
Total	**1**	**18**	**18**	**11**	**48**

TABLE 5-5.
CRITICAL INFRASTRUCTURE IN THE PLANNING AREA

Facility Type	Bridges	Potable Water	Waste Water	Natural Gas	Power	Communications	Transportation	Dams	**Total**
City of Trinidad	23	4	1	7	3	1	1	1	**41**
Town of Aguilar	0	0	0	0	0	0	0	0	**0**
Town of Cokedale	0	0	0	0	0	0	0	0	**0**
Stonewall FPD	27	4	1	4	0	0	0	9	**45**
Unincorporated	169	3	1	0	0	0	1	30	**204**
Total	**219**	**11**	**3**	**11**	**3**	**1**	**2**	**40**	**290**

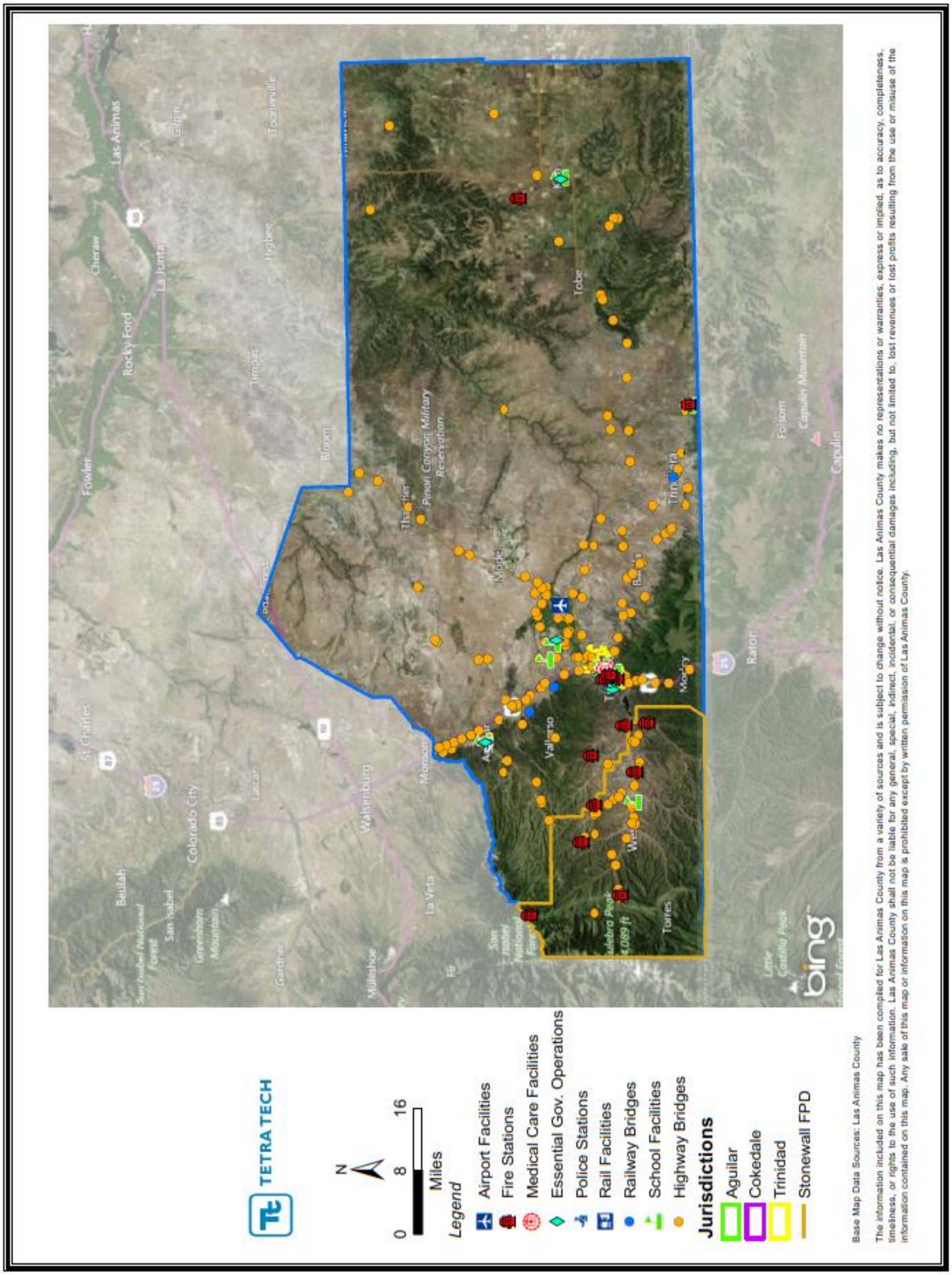


Figure 5-6. Critical Facilities in Las Animas County

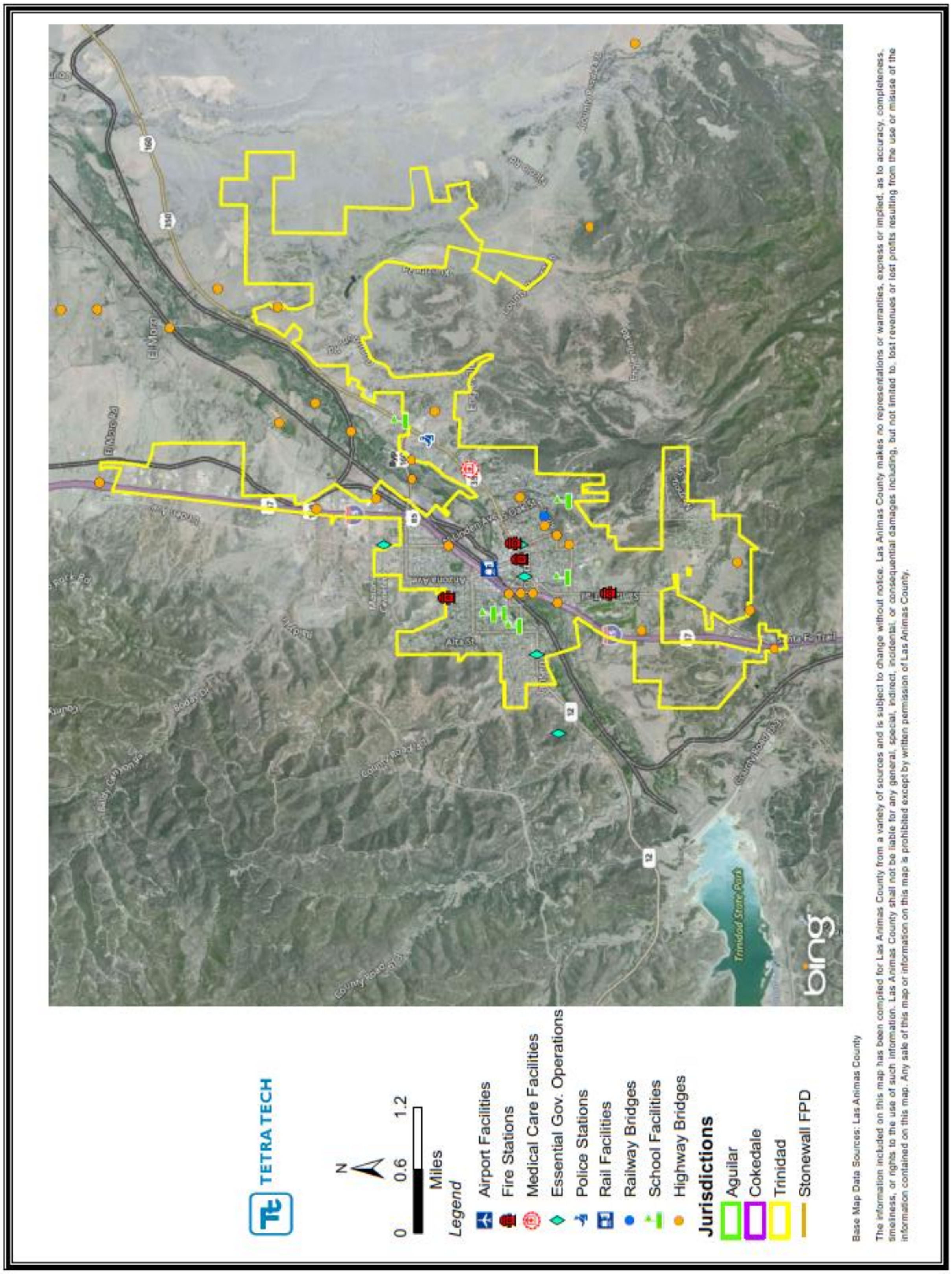


Figure 5-7. Critical Facilities in the City of Trinidad

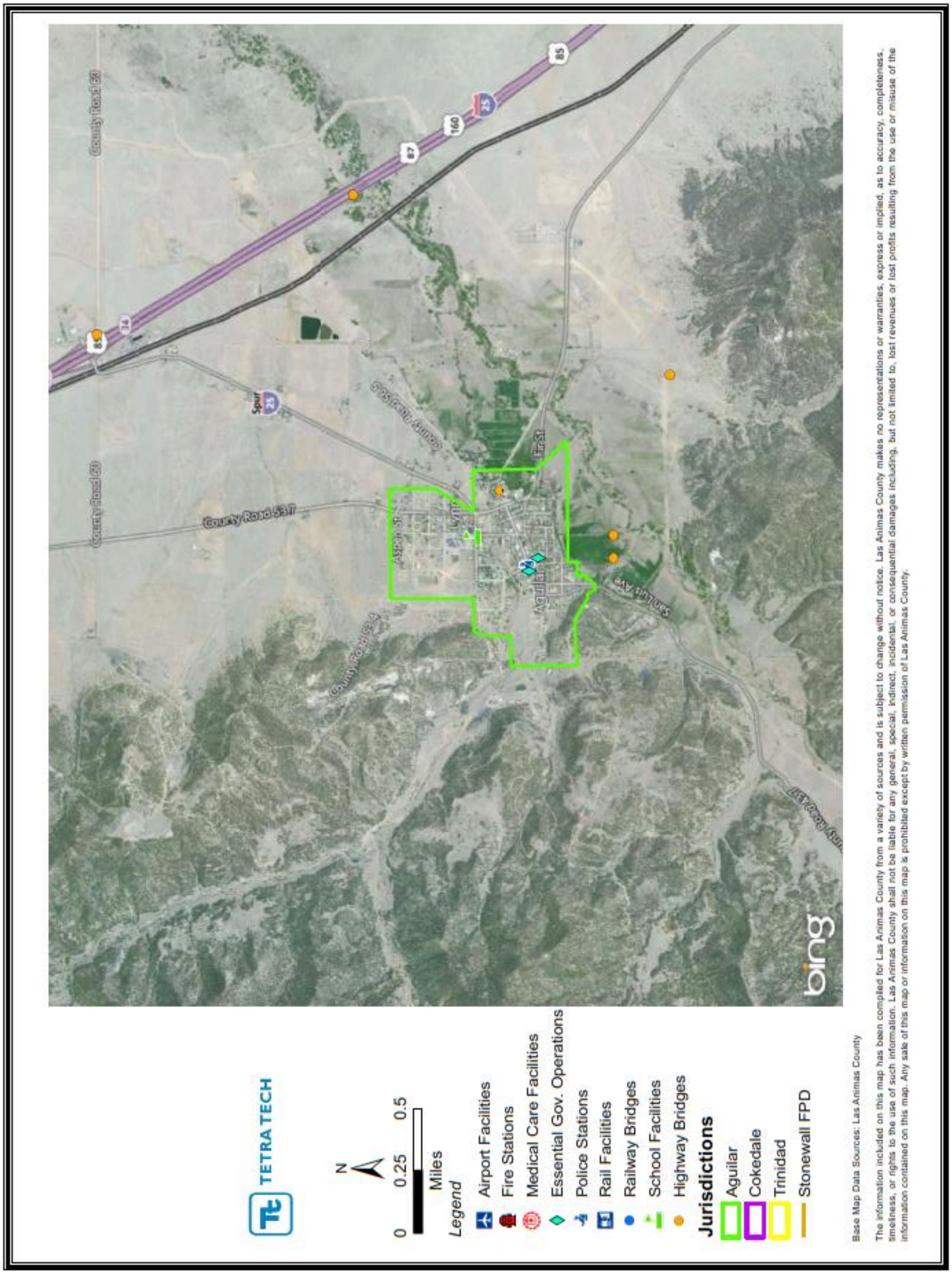


Figure 5-8. Critical Facilities in the Town of Aguilar

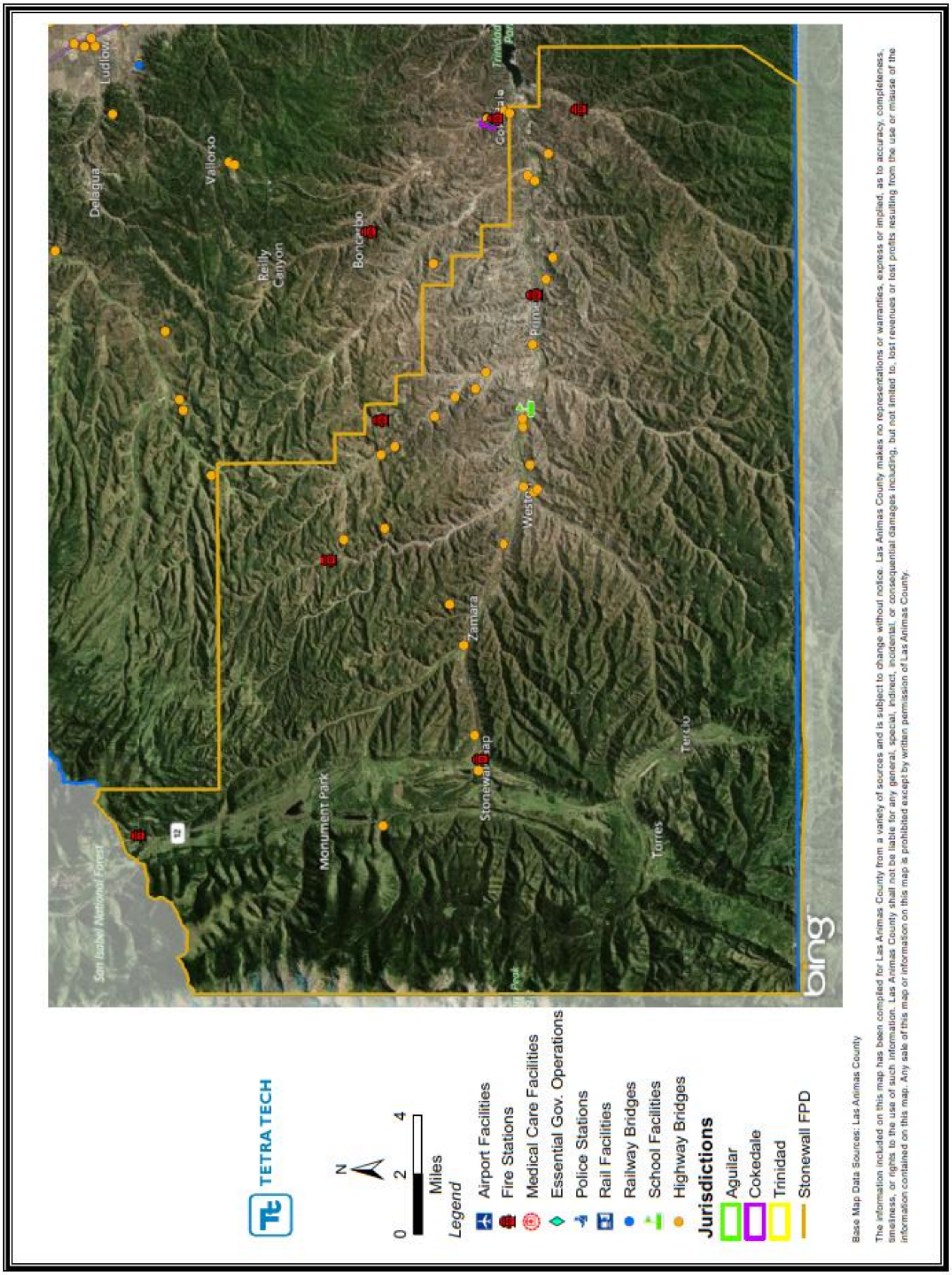


Figure 5-9. Critical Facilities in the Town of Cokedale and the Stonewall Fire Protection District

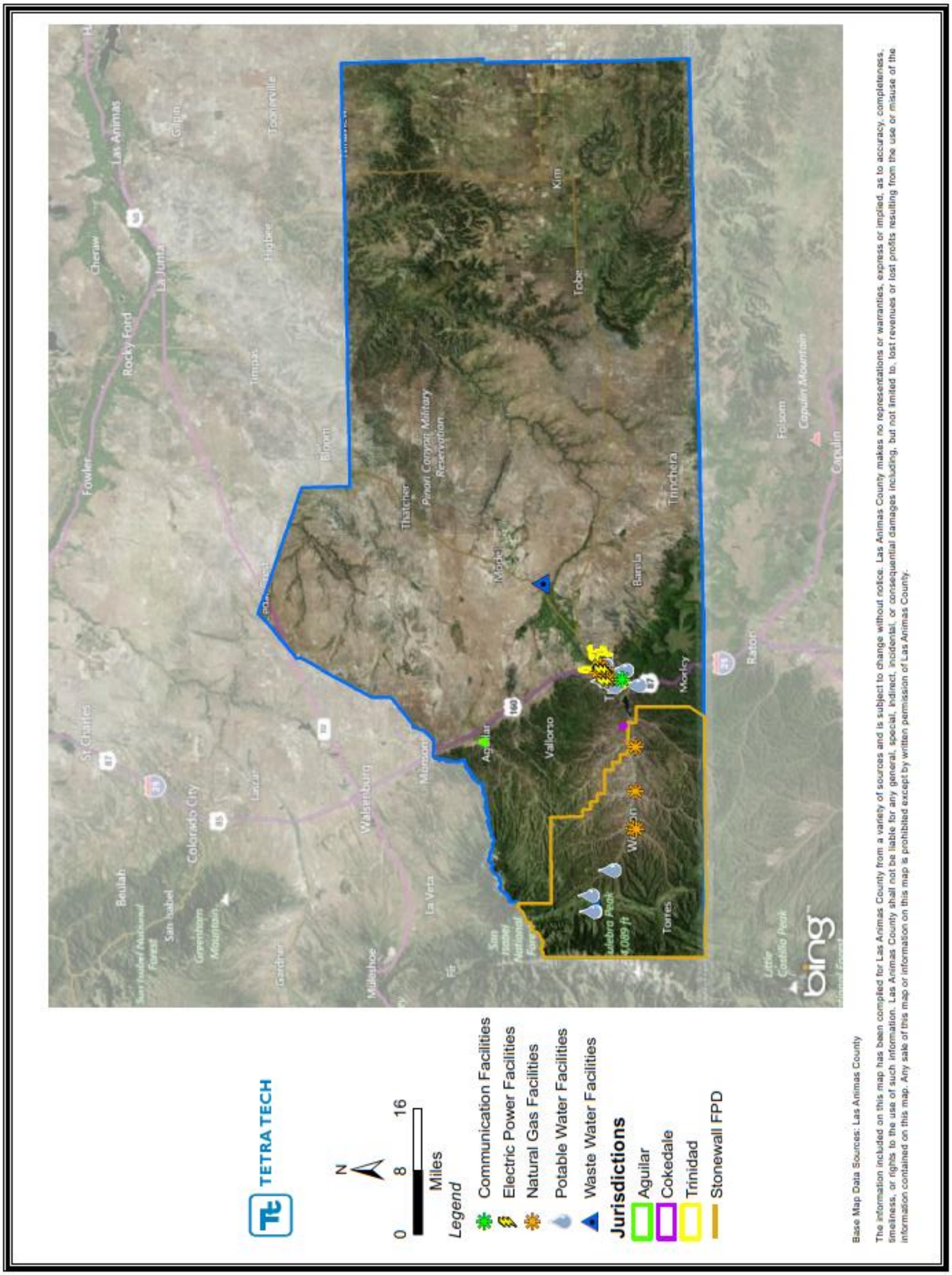


Figure 5-10. Critical Utilities in Las Animas County

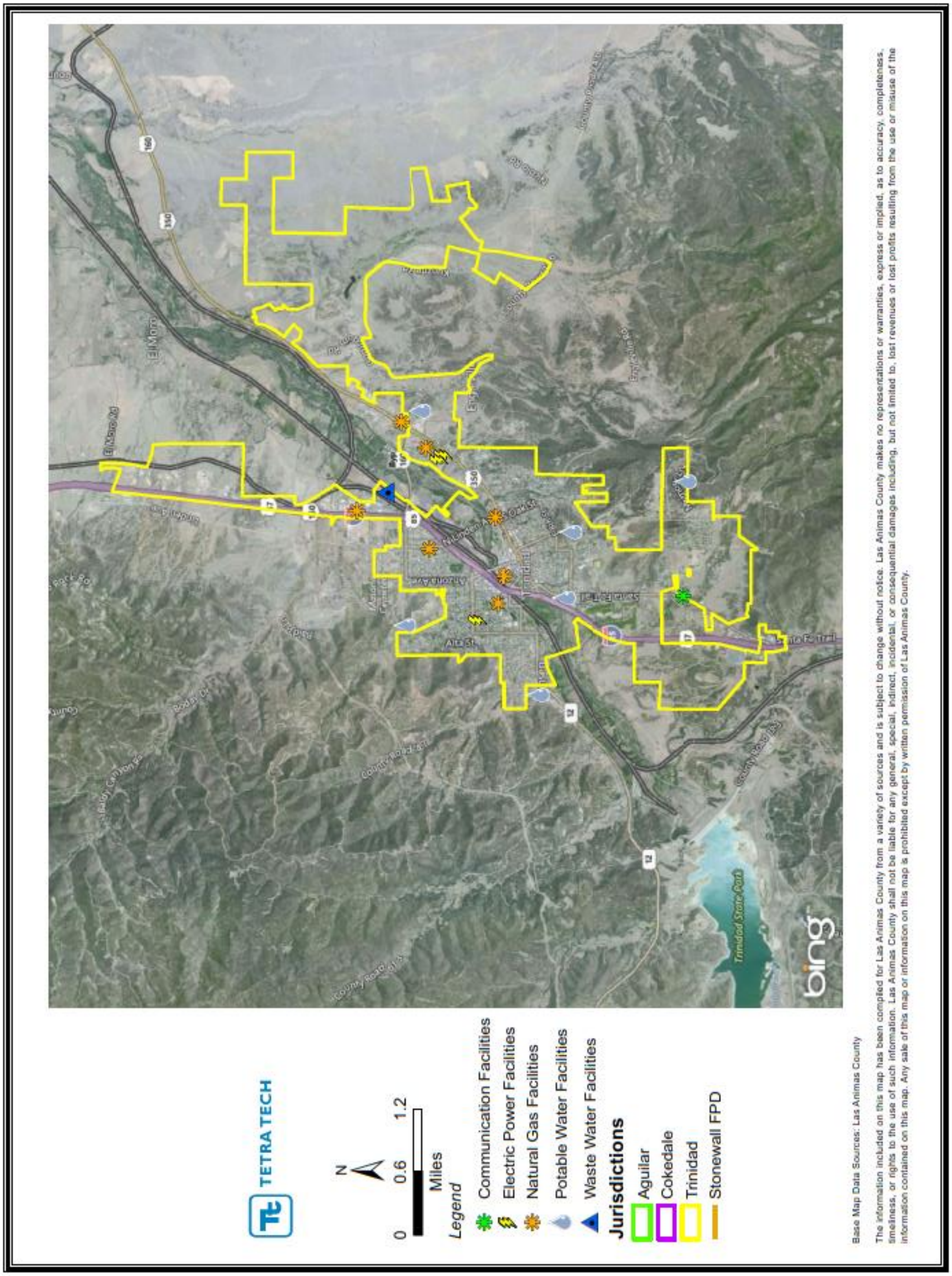


Figure 5-11. Critical Utilities in the City of Trinidad

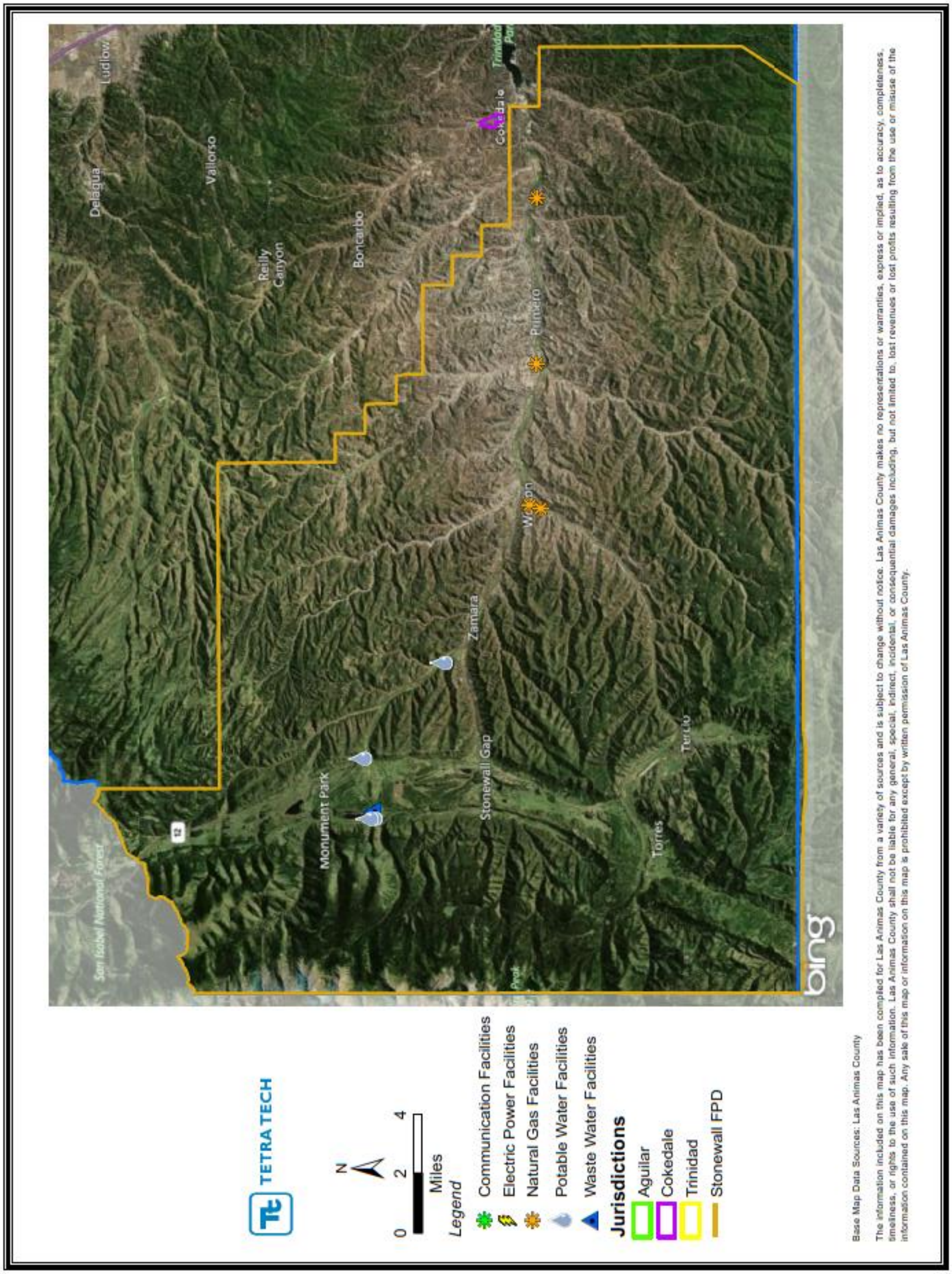


Figure 5-12*. Critical Utilities in the Town of Cokedale and the Stonewall Fire Protection District*

5.6 DEMOGRAPHICS

Information on population and how it has changed in the past and may change in the future is needed for making informed decisions about the future. Population directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Population changes are useful socio-economic indicators, as a growing population generally indicates a growing economy, and a decreasing population signifies economic decline.

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would assist the county in extending focused public outreach and education to these most vulnerable citizens. Select 2010-2014 5-Year American Community Survey demographic and social characteristics for Las Animas County are shown in Table 5-6. The Stonewall Fire Protection District is not included in the 5-Year American Community Survey demographic data as they do not collection data on fire districts.

TABLE 5-6.
LAS ANIMAS COUNTY 2014 DEMOGRAPHIC AND SOCIAL CHARACTERISTICS

	Las Animas County	Trinidad	Aguilar	Cokedale
Gender/Age (% of Total Population)				
Male	51.4%	50.4%	53.8%	55.2%
Female	48.6%	49.6%	46.2%	44.8%
Under 5 years	5.1%	5.6%	5.5%	3.4%
65 years and over	19.9%	17.6%	26.1%	12.4%
Race/Ethnicity (% of Total Population)				
White	84.5%	82.6%	73.0%	93.1%
American Indian/Alaska Native	2.1%	3.1%	1.2%	0.0%
Asian	0.6%	0.8%	0%	0.0%
Black or African American	1.3%	1.5%	0%	0.0%
Hawaiian or Pacific Islander	0.2%	0.2%	0%	0.0%
Other Race	6.7%	7.1%	21.0%	2.1%
More Than One Race	4.6%	4.7%	4.8%	4.8%
Hispanic or Latino (of any race)	42.2%	51.2%	52.0%	23.4%
Education (% of Total >25 Population)				
High school graduate or higher	85.7%	85.9%	72.2%	100%

Source: U.S. Census Bureau, 2010-2014 5-Year American Community Survey, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

5.6.1 Population

Las Animas County is the 33rd most populous of Colorado's 64 counties. Colorado's Department of Local Affairs estimated the planning area's population at 14,789 as of July 2014. Table 5-7 shows planning area population data from 1990 through 2014. The total Las Animas County population increased 10.5% from 1990 to 2000 but decreased by 4.5% from 2000 to 2014.

TABLE 5-7.
LAS ANIMAS COUNTY POPULATION (1990-2014)

	Total Population					
	1990	1995	2000	2005	2010	2014
Trinidad	8,580	9,047	9,140	9,011	9,033	8,131
Aguilar	520	594	595	559	534	479
Cokedale	116	128	140	135	128	117
Unincorporated Areas*	4,657	4,740	5,472	5,876	5,940	6,062
County Total	**13,757**	**14,381**	**15,207**	**15,446**	**15,507**	**14,789**

Sources: Colorado Department of Local Affairs https://dola.colorado.gov/demog_webapps/mpeParameters.jsf;jsessionid=d3953e08cbc6801412bc17561485

U.S. Census Bureau, 2010-2015-Year American Community Survey, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

* Includes non-participating communities

The City of Trinidad is the county's principal population center. In 1990, 62% of the planning area's residents lived in Trinidad. In 2014, approximately 55% of the population lived in Trinidad.

Figure 5-13 shows the population change in the planning area and the State of Colorado from 1990 to 2014. Between 1990 and 2014, Colorado's population grew by 55.4% (about 2.3% per year) while the planning area's population increased by 7.5% (0.3 percent per year).

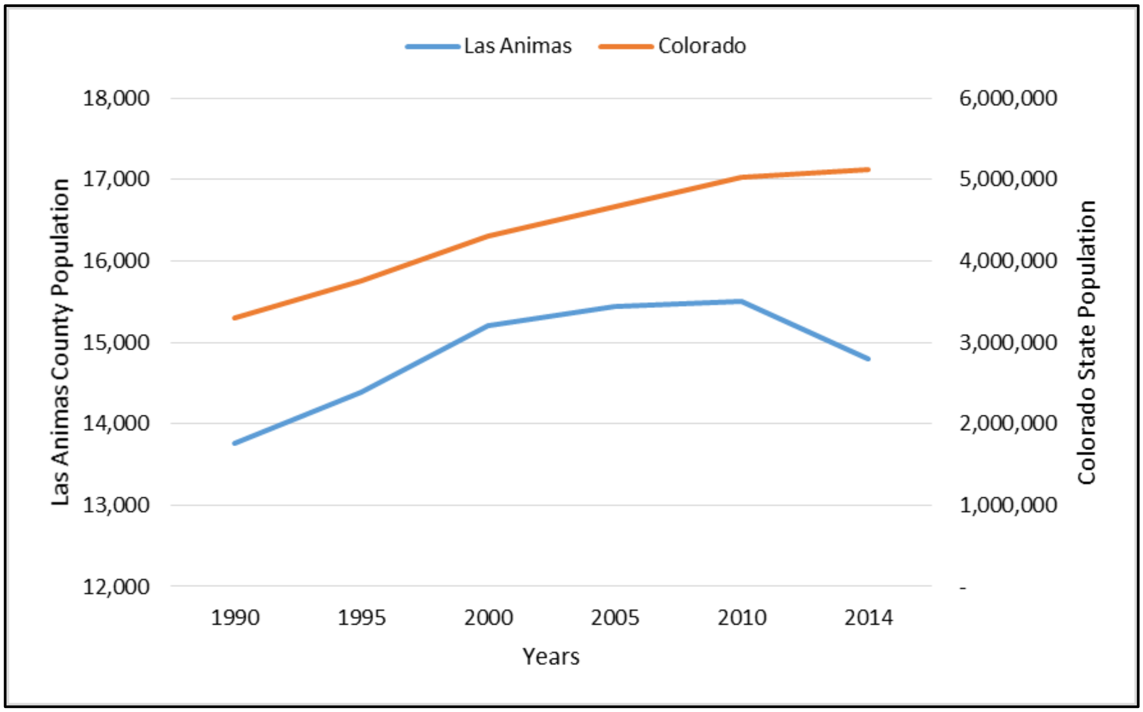


Figure 5-13. State of Colorado and Planning Area Population Growth

5.6.2 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

The overall age distribution for the planning area is illustrated in Figure 5-14. Based on U.S. Census data estimates, 19.9% of the planning area's population is 65 or older. U.S. Census data does not provide information regarding disabilities in the planning area's over-65 population. U.S. Census estimates for 2014 indicate that 16.2% of Las Animas County families have children under 18 and are below the poverty line. It is also estimated that 16.1% of the county's population is 14 or younger.

Source: U.S. Census Bureau, 2010-2014 5-Year American Community Survey

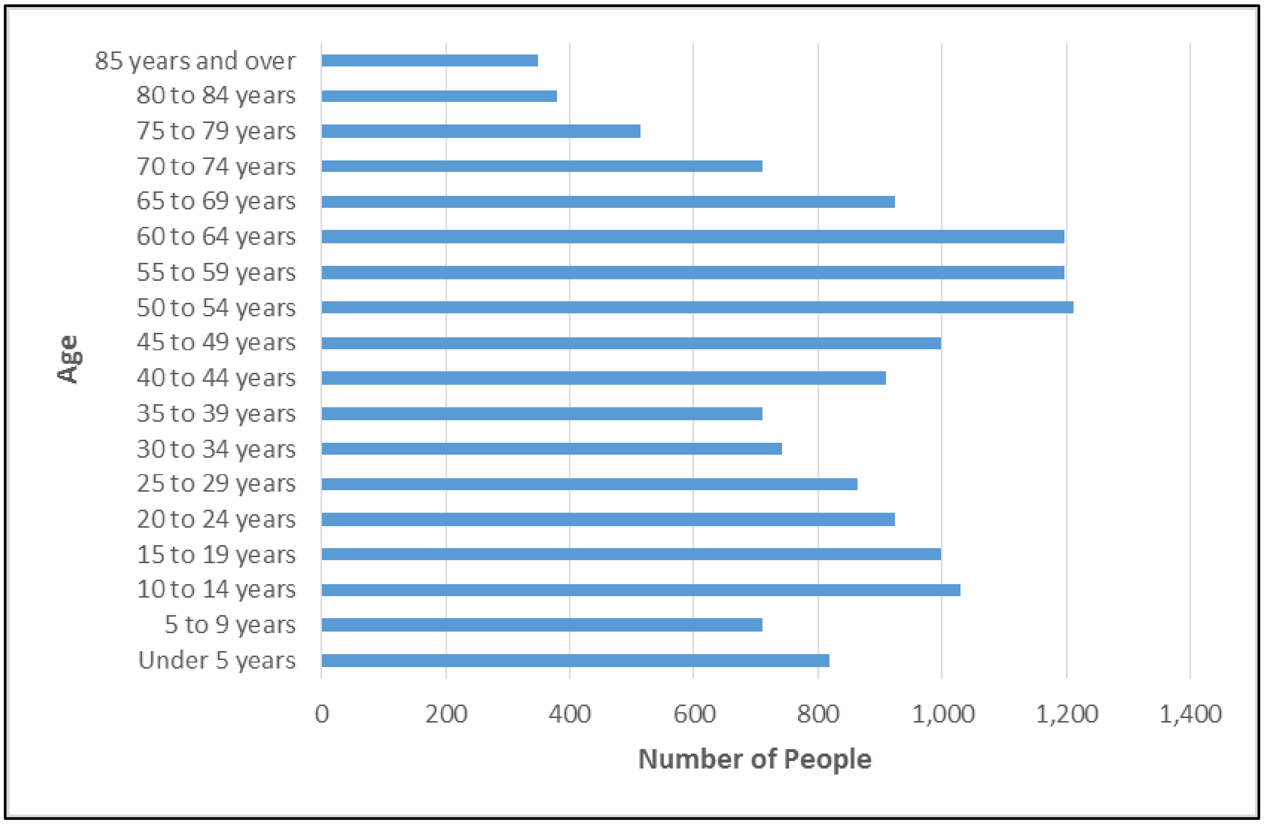


Figure 5-14. Las Animas County Age Distribution

5.6.3 Disabled Populations

The 2010 U.S. Census estimates that 54 million non-institutionalized Americans with disabilities live in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. According to the 2014 U.S. Census Bureau estimates, 46.3% of the total civilian non-institutionalized population lives with some form of disability.

5.6.4 Ethnic Population

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the U.S. Census, the racial composition of the planning area is predominantly white, at approximately 84.5 percent. The largest minority population is Hispanic or Latino (of any race) at 42.2 percent. Figure 5-15 shows the population distribution by race in the planning area.

Source: U.S. Census Bureau, 2010-2014 5-Year American Community Survey

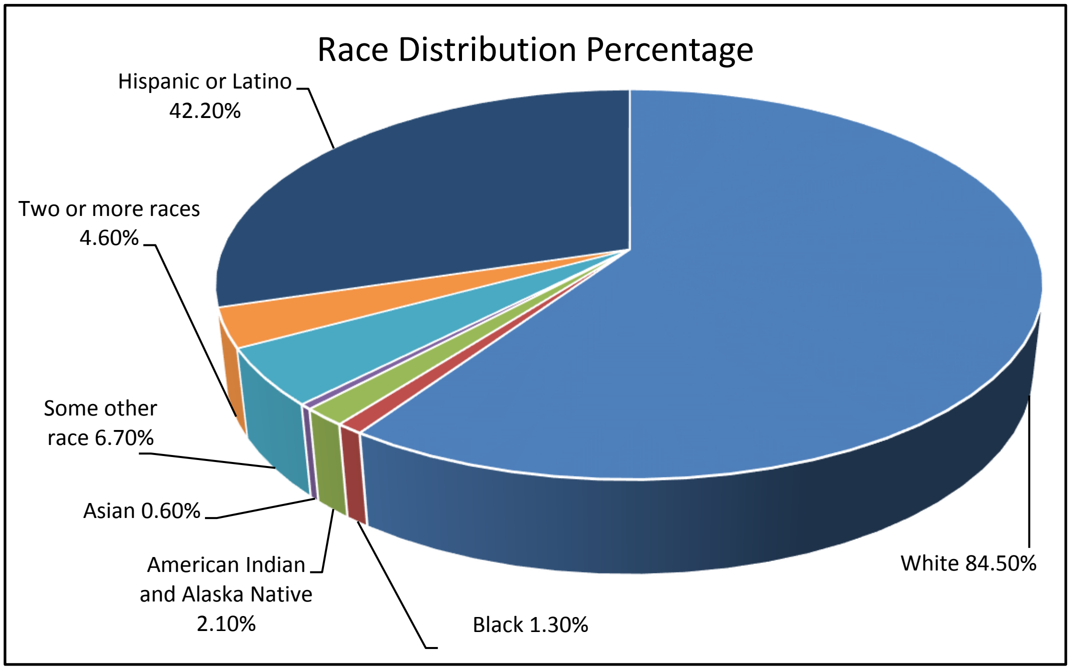


Figure 5-15. Las Animas County Race Distribution

The planning area has a 3.3-percent foreign-born population. Other than English, the most commonly spoken language in the planning area is Spanish. The U.S. Census Bureau estimates 3.6 percent of the residents speak English "less than very well."

5.7 ECONOMY

Select 2014 economic characteristics estimated for Las Animas County by the U.S. Census Bureau are shown in Table 5-8.

TABLE 5-8.
LAS ANIMAS COUNTY 2014 ECONOMIC CHARACTERISTICS

	Las Animas County	Trinidad	Aguilar	Cokedale
% of families below poverty level	10.2%	11.5%	7.0%	0.0%
% of individuals below poverty level	16.3%	18.3%	18.5%	0.0%
Median home value	$151,200	$140,300	$83,300	$68,300
Median household income	$56,199	$44,063	$53,750	$68,250
Per capita income	$23,365	$22,761	$22,342	$20,901
% of Population >16 in Labor Force	56.7%	60.6%	46.2%	77.2%
% of Population Employed	51.6%	55.0%	39.7%	77.2%

Source: U.S. Census Bureau, 2010-2014 5-Year American Community Survey, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

5.7.1 Income

In the United States, to some extent individual households are expected to use private resources to prepare for, respond to, and recover from disasters. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau estimates, per capita income in the planning area in 2014 was $23,365, and the median household income was $56,199. It is estimated that about 10.9 percent of households receive an income between $100,000 and $149,999 per year and 2.7 percent are above $150,000 annually. Families with incomes below the poverty level in 2014 made up 10.2 percent of all families and 16.3 percent of the total county population.

5.7.2 Employment Trends

According to the U.S. Bureau of Labor Statistics, Las Animas County's unemployment rate as of September 1, 2015, was 5.1 percent, compared to a statewide rate of 4.0 percent. Figure 5-16 shows Las Animas County's unemployment trends from 1990 through September 1, 2015. Las Animas County's unemployment rate was lowest in 2007 at 3.1 percent and peaked in 2013 at 13.1 percent.

Source: U.S. Bureau of Labor Statistics, 2015

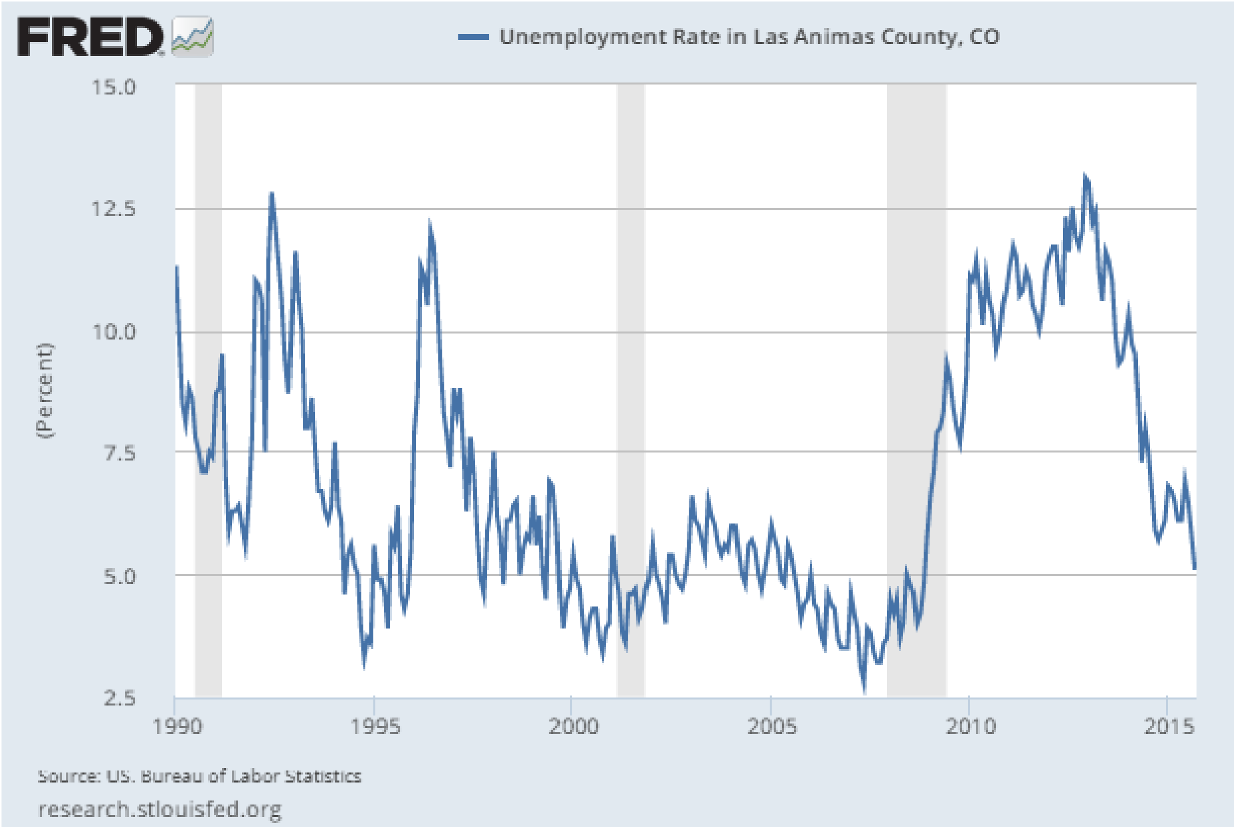


Figure 5-16. Las Animas County Unemployment Rate

According to the 2014 American Community Survey, about 56.7% of Las Animas County's population 16 years and older is in the labor force, including 51.5% of women and 48.5% of men.

5.7.3 Occupations and Industries

According to 2014 U.S. Census Bureau estimates, the planning area's economy is strongly based in the education, health care and social assistance industries (22.5% of total employment), followed by retail trade (12%), and agriculture, forestry, fishing and hunting, and mining (11.9%). Figure 5-17 shows the distribution of industry types in Las Animas County, based on share of total employment.

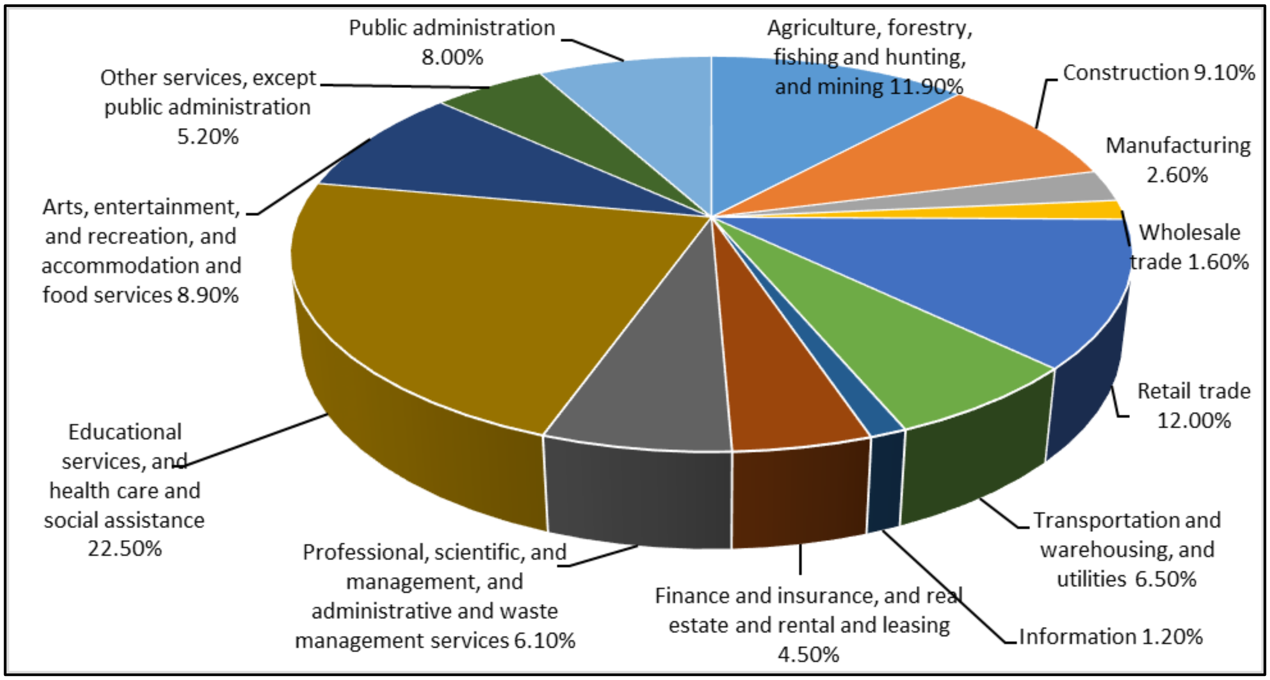


Figure 5-17. Percent of Total Employment by Industry in Las Animas County

According to the Colorado Department of Labor and Employment, the following are the largest employers in Las Animas County (Colorado LMI, 2015 Gateway website, https://www.colmigateway.com):

- Evergreen Operating Corporation
- Trinidad State Junior College
- Walmart Supercenter
- Corrections Department
- Trinidad Inn Nursing Home
- Quality Inn
- Comcast
- First National Bank - Trinidad

The U.S. Census estimates that 74.9% of Las Animas County workers commute alone (by car, truck or van) to work, and the mean travel time to work is 20.9 minutes.

5.8 FUTURE TRENDS IN DEVELOPMENT

The municipal planning partners have adopted comprehensive plans that govern land use decision and policy making in their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area.

All municipal planning partners will incorporate this hazard mitigation plan update in their comprehensive plans by reference. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

The present land use in Las Animas County is shown on Table 5-9.

**TABLE 5-9.
PRESENT LAND USE IN THE PLANNING AREA**

Present Use Classification	Area (acres)	% of Total Land Area
Agriculture	30,622	1.00
Barren Land	5,175	0.17
Developed, Open Space	12,414	0.41
Developed, High Intensity	50	0.00
Developed, Medium Intensity	337	0.01
Developed, Low Intensity	2,861	0.09
Forest Land	565,427	18.51
Grassland/Prairie	2,415,240	79.07
Water/Wetland	22,461	0.74
Total	**3,054,587**	**100.0**

5.9 LAWS, ORDINANCES, AND AGENCIES

Existing laws, ordinances and plans at the federal, state and local level can support or impact hazard mitigation initiatives identified in this plan. In addition, federal, state, and local agencies perform functions that support hazard mitigation. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). Pertinent federal, state and local laws are described below.

5.9.1 Federal

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It requires that state and local governments develop, adopt, and routinely update a hazard mitigation plan in order to remain eligible for pre- and post-disaster mitigation funding. These funds include the Hazard Mitigation Assistance (HMA) grants of the HMGP, Pre-Disaster Mitigation (PDM), and the Flood Mitigation Assistance (FMA) programs that are administered by FEMA. This plan is designed to meet the requirements of DMA, allowing the planning partners to be eligibility for future HMA grants.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife, and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA’s purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." For salmon and other vertebrate species, this may include subspecies and distinct population segments.
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The NOAA Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding, or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

The Clean Water Act

The Federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. Las Animas County and the City of Trinidad participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, Las Animas County and City of Trinidad were in good standing with NFIP requirements. The Town of Aguilar participates as emergency status until the Flood Insurance Rate Map and applicable flood ordinances are adopted and the Town of Cokedale does not participate. The County's current Federal Insurance Rate Map (FIRM) was effective April 3, 1984.

Federal Emergency Management Agency

The Federal Emergency Management Agency's (FEMA) mission remains "to lead America to prepare for, prevent, respond to, and recover from disasters with a vision of 'A Nation Prepared.'" FEMA coordinates the federal government's role in preparing for, preventing, mitigating the effects of, responding to, and recovering from all domestic disasters, whether natural or man-made, including acts of terror.

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-707, was signed into law November 23, 1988; and amended the Disaster Relief Act of 1974, Public Law 93-288. It created the system in place today by which a presidential disaster declaration of an emergency triggers financial and physical assistance through FEMA. The Act gives FEMA the responsibility for coordinating government-wide relief efforts. On March 1, 2003, FEMA became part of the U.S. Department of Homeland Security (DHS).

United States Forest Service

The United States Forest Service (USFS) is an agency of the USDA that administers the nation's 154 national forests and 20 national grasslands. The mission of the USFS is "To sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." Its motto is "Caring for the land and serving people." As the lead federal agency in natural resource conservation, the USFS provides leadership in the protection, management, and use of the nation's forest, rangeland, and aquatic ecosystems. The agency's ecosystem approach to management integrates ecological, economic, and social factors to maintain and enhance the quality of the environment to meet current and future needs. Through implementation of land and resource management plans, the agency ensures sustainable ecosystems by restoring and maintaining species diversity and ecological productivity that helps provide recreation, water, timber, minerals, fish, wildlife, wilderness, and aesthetic values for current and future generations of people.

Bureau of Land Management

The Bureau of Land Management (BLM) is an agency within the United States Department of the Interior that administers more than 247.3 million acres of public lands in the United States. President Harry S. Truman created the BLM in 1946 by combining two existing agencies— the General Land Office and the Grazing Service. The mission of the BLM is "to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations."

BLM programs include: grazing, mining, coal leases, recreation, California Desert Conservation Area, timberlands, firefighting, mineral rights on Indian lands, cadastral surveys, abandoned mines, energy corridors, helium (the BLM operates the National Helium Reserve in Texas), and revenue and fees. The BLM also oversees the National Landscape Conservation System, functions as a federal law enforcement agency to enforce laws and regulations governing BLM lands and resources, manages the wild horse and burro program, and oversees renewable energy projects on BLM-managed lands.

The BLM is also a leader in the nation's wildland fire management efforts, undertaking a broad range of activities to safely protect the public, the natural landscape, wildlife habitat and recreational areas. The program includes fire suppression, preparedness, predictive services, fuels management, fire planning, community assistance and protection, prevention and education, and safety.

National Park Service

The National Park Service is an agency of the United States government that manages all U.S. national parks, many American national monuments, and other conservation and historical properties. It was created on August 25, 1916, by Congress through the National Park Service Organic Act and is an agency of the United States Department of the Interior.

The National Park Service "preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world."

5.9.2 State and Regional

Colorado Division of Emergency Management

Pursuant to House Bill 12-1283, the former Division of Emergency Management moved from the Department of Local Affairs to the newly created Colorado DHSEM under the Colorado Department of Public Safety, effective July 1, 2012. The division is now comprised of three offices:

- Office of Emergency Management
- Office of Preparedness
- Office of Prevention and Security

DHSEM operate under the following division mission: "The mission of the Division of Homeland Security and Emergency Management is to support the needs of local government and partner with them before, during, and after a disaster and to enhance preparedness statewide by devoting available resources toward prevention, protection, mitigation, response, and recovery, which will ensure greater resiliency of our communities." The Division vision is: "The vision of the Division of Homeland Security and Emergency Management is to unify homeland security and emergency management within the Colorado Department of Public Safety to support tribal and local government and ensure State and Federal agency coordination."

Colorado Water Conservation Board

The CWCB is an agency of the State of Colorado. The CWCB Flood Protection Program is directed to review and approve statewide floodplain studies and designations prior to adoption by local governments. The CWCB is also responsible for the coordination of the NFIP in Colorado and for providing assistance to local communities in meeting NFIP requirements. This includes CWCB prepared or partnered local floodplain studies.

Colorado Geological Survey

The Colorado Geological Survey is a state government agency within the Colorado Department of Natural Resources whose mission is to help reduce the impact of geologic hazards on the citizens of Colorado, to promote responsible economic development of mineral and energy resources, provide geologic insight into water resources, provide avalanche safety training and forecasting, and to provide geologic advice and information to a variety of constituencies. The CAIC is housed in the Colorado Geological Survey.

Colorado State Forest Service

The mission of the Colorado State Forest Service is to provide for the stewardship of forest resources and to reduce related risks to life, property, and the environment for the benefit of present and future generations. Its fire preparedness and response strategic priority is to provide leadership in wildland fire protection for state and private lands in Colorado and reduce wildfire-related loss of life, property, and critical resources.

South Central Council of Governments

The South Central Council of Governments works with local entities in the Huerfano and Las Animas Counties in numerous ways, including assisting with grant application to both state and local agencies and setting up community-need programs, such as meals for senior citizens, transit services, day care services, and housing rehabilitation.

Officially formed in 1975, South Central Council of Governments represents a collaboration between area government and agencies to enhance community services and increase available funding levels to raise local standards of living.

Southern Colorado Economic Development District

The Southern Colorado Economic Development District is a non-profit organization whose membership is the 12 counties of southeastern Colorado. Their primary focus is to provide economic development planning and technical assistance to the twelve member counties.

Southern Colorado Regional Emergency Medical and Trauma Advisory Council

The Southern Colorado Regional Emergency Medical and Trauma Advisory Council is a joint trauma medical emergency region and an Area Trauma Advisory Council created by Resolution No. 01-191, dated July 10, 2001. It has an Intergovernmental Agreement between Custer, Fremont, Huerfano, and Las Animas Counties to create the Southern Colorado Regional Emergency Medical and Trauma Advisory Council.

Upper Huerfano Conservation District

The Upper Huerfano Conservation District was organized in 1940 under Colorado's Soil Conservation District Law. The district currently has 925,949 acres in Huerfano County and northern Las Animas County. The primary concerns of the district include: rangeland/pasture land health, forest land health, water quality/quantity, wildlife habitat, and special projects including education.

5.9.3 Las Animas County

County government is made up of the following offices and departments:

- Airport
- Administration
- Assessor
- Attorney
- Clerk and Recorder
- Commissioners
- Coroner
- Emergency Management
- Fairgrounds
- Human Services
- Finance and Accounting
- Land Use
- Public Health
- Road & Bridge
- Sheriff
- Surveyor
- Treasurer
- Veteran Services
- Weed Control

Excerpts from applicable policies, regulations, and plans, and descriptions of applicable programs follow to provide more detail on existing mitigation capabilities.

Comprehensive Land Use Plan, 2001 (Addendum 2009)

The Las Animas County Comprehensive Land Use Plan is the official document for guiding both the public and private sector in land use decision for the county. The original plan was adopted in 2001 and a 2009 plan addendum establishes the preferred plan map with four primary planning areas as:

- Established Community Areas
- Cooperative Planning Areas
- Rural Resource Areas
- Rural Conservation Areas

The 2009 plan addendum addresses plan concepts and policy recommendations by planning areas and county-wide that can be integrated and complement the hazard mitigation plan initiatives.

Land Use Regulations, 2013

The Las Animas County Land Use Regulations applies to all the land in the unincorporated areas of the county. Las Animas County has adopted resolutions and ordinances that directly or indirectly mitigate hazards identified in this plan. The Land Use Regulations includes the following chapters:

- Chapter 1: General Provisions, Application and Building Codes
- Chapter 2: Development Review
- Chapter 3: Zoning Regulations and Maps
- Chapter 4: Subdivision Regulations
- Chapter 5: Planned Unit Developments
- Chapter 6: Sign Code Regulations
- Chapter 7: Supplementary Regulations
- Chapter 8: Mobile Home Park and Campground Regulations
- Chapter 9: Oil and Gas Regulations
- Chapter 10: Flood Damage Prevention Regulations
- Chapter 11: Regulations for Areas and Activities of Local Concern and State Interest
- Chapter 12: Fees
- Chapter 13: Enforcement, Violations and Penalties

Noxious Weed Program

The Weed Management Plan, 2007 was developed because noxious weeds have become a threat to the natural resources of Colorado. An organized and coordinated effort must be made to stop the spread of noxious weeds. The 2007 plan established a Noxious Weed Program. The objectives and goals of the program are education, mapping, and support of private enterprise.

The mission of the Las Animas County Noxious Weed Program is to educate county residents, property owners, and managers to be responsible stewards of the land and resources of Las Animas County by protecting and preserving all lands and natural resources of the county from the degrading impact of invasive noxious weeds.

Other Community Wildfire Protection Plans

Several communities within Las Animas County have developed independent CWPPs. These CWPP are described briefly below:

- **Santa Fe Trail Estate Wildfire Protection Plan, 2006:** The Santa Fe Trail Ranch community, located south of Trinidad, is near the Colorado/New Mexico state line. Interstate Highway 25 provides primary access to the ranch. It covers approximately 16,800 acres and ranges in elevation from 6,500 to 8,100 feet. The community, as described in the CWPP, includes 454 lots (35 acre parcels) of which 145 have structures of them. Approximately six to eight new homes are being built each year. Fisher's Peak Fire Protection District (FPD) Volunteer Fire Department provides local protection.

  In addition to this CWPP, the Santa Fe Trail Ranch community is a recognized FireWise Community by the Colorado State Forest Service and the National Fire Protection Association.

- **Spirit Mountain Ranch Community Wildfire Protection Plan, 2008:** The Spirit Mountain Ranch community, located about 34 miles north of the Colorado/New Mexico state line and about 8 miles west of the Town of Aguilar. It lies on the southeast flank of the Spanish Peaks, covers approximately 1,500 acres and ranges in elevation from 6,950 to 7,300 feet above meal sea level. The community, as considered in the CWPP, includes 43 lots (35 acres parcels) of which 27 have structures (homes or barns). The Spanish Peaks FPD Volunteer Fire Department, with stations in Aguilar and Gulnare, provides local protection.

- **Stonewall Fire Protection District Community Wildfire Protection Plan, 2014:** The Stonewall Fire Protection District (SFPD), located in the western portion of Las Animas County, provides services in the area of 547 square miles of wildland urban interface (WUI). Altitudes range from 6,000 feet to 14,000 feet above mean sea level. The SFPD is bounded by New Mexico on the south, Costilla County to the west, Huerfano County, and La Veta FPD on the northwest, and the Spanish Peaks/Boncarbo FPD on the east. It includes private land as well as land owned by BLM, USFS, Colorado State Land Board, Colorado Parks and Wildlife, and the City of Trinidad. The goals of the SFPD CWPP include: enhance the safety of residents and responders; increase organizational and interagency readiness; and reduce the risk of catastrophic wildland fires.

Office of Emergency Management

The Las Animas County OEM coordinates with all county fire and emergency medical service (EMS) providers, as well as the county Sheriff's Office, to prepare and plan for emergencies in Las Animas County. This is accomplished by developing a county Emergency Operations Plan, participating in local and regional workgroups, planning and coordinating emergency training and exercises, and supporting public education in emergency preparedness. In addition, communication is maintained with state and federal agencies for coordination in the event of large disasters, natural or manmade. After the disaster, the OEM coordinates and assists with the recovery efforts to restore the community.

Building Department

The Building Inspector is a shared position with the City of Trinidad and is responsible for inspections of all phases of commercial and residential construction.

Land Use

The mission of the Department of Land Use is to guide and assist landowners and businesses in complying with the Las Animas County Land Use Regulations. New construction and remodeling for commercial and industrial buildings or structures requires compliance with 2009 International Building Code standards.

District Health Department

Las Animas-Huerfano Counties District Health Department serves both these counties. The mission of the District Health Department is to promote preventative health, education, and to provide healthcare services that will enhance the quality of life for citizens of Las Animas and Huerfano Counties.

Public health staff provides a variety of services including immunizations, preventive assessments of children and the elderly, and a full range of services designed to assist individuals and groups to attain and maintain good health and to cope with illnesses.

In particular, the District Health Department has an Emergency Preparedness and Response Coordinator that works with local agencies to inform, educate, and empower the community about public health related disaster preparedness. The Emergency Preparedness and Response Coordinator provide training and exercises to provide a competent public health work force. The department also participates in a regional Health Care Coalition to collaborate with other medical and health-related agencies within the region. When necessary, the Emergency Preparedness and Response Coordinator responds to local and state disasters to coordinate public health efforts.

Fire Protection Districts and Ambulance District

There are nine FPDs and one ambulance district that provide emergency protection in Las Animas County. Five of the nine FPDs are participating in tandem with Las Animal County for this planning effort and are profiled below. The SFPD is participating individually in this planning process and is profiled separately. The City of Trinidad FPD is participating with the City of Trinidad and the Cokedale Fire Department is participating with the Town of Cokedale. The Pinon FPD is operated by the U.S. Department of Defense and is not participating in this planning effort. Figure 5-18 shows the FPD's boundaries based upon best available data from Las Animas County Road and Bridge Department.

Branson FPD: This is a very small volunteer group that has no tax base and relies on donations. The water tender and fire truck are housed at the Las Animas County garage in the Town of Branson. The coverage area is about the same as the school district boundary. The Branson FPD responds to grass, brush, structure, and vehicle fires.

Fisher's Peak FPD: The Fisher's Peak FPD is an all-volunteer fire and rescue department with approximately 22 volunteers. It operates out of the Town of Starkville with one fire station, which is one mile south of the City of Trinidad. The Fisher's Peak FPD's geographic area includes approximately 18 miles of Interstate-25, the Town of Starkville, a section of Highway 12, a portion of the City of Trinidad, as well as multiple subdivisions (Santa Fe Trail Ranches and Trinidad Lake Ranches) around the county. The firefighters have hazardous materials (HAZMAT) awareness-level capability.

Hoene FPD: The Hoene FPD has approximately 20 volunteer firefighters that operate out of one fire station in the Town of Hoehne. The Hoene FPD's geographic area includes 900 square miles including the Town of Hoehne. The firefighters have the capability to provide basic life support emergency medical services, wildland and structural suppression, vehicle extrication, and low angle rescue. The majority of their responses are to wildland fires.

Kim FPD: The Kim FPD is governed by a Fire Board and has approximately 20 volunteer firefighters that operate out of one fire station in the Town of Kim. The Kim FPD does not have a tax base and relies on donations. The coverage area is about the same as the Kim school district boundary. Fire equipment is housed in a building attached to Las Animas County Garage in Kim. This FPD includes a lot of the USFS National Grasslands area and the Kim FPD works with the USFS out of La Junta and Springfield. The Kim FPD responds to grass, brush, structure, and vehicle fires. They respond to incidents on Highway 160 on a regular basis where there is heavy truck traffic.

Spanish Peaks-Boncarbo FPD: The Spanish Peaks Boncarbo FPD is the merging of two fire departments (Spanish Peaks in Aguilar, and Boncarbo north of Cokedale) with one district board government both fire departments. Both fire departments are comprised of volunteer firefighters.

The Spanish Peaks Fire Department has the main fire station in the Town of Aguilar, a substation at Gulnare and another along I-25 at the Hoehne exit (mile marker 23). These volunteer fire fighters respond to grass, forest, structure, and vehicle fires. The department has about 20 miles of I-25 under its coverage area plus the BNSF railroad as it runs north-south by I-25.

The Boncarbo Fire Department has their station in Bon Carbo and has a large area to cover for grass, forest, structure, and vehicle fires including some 13,000 acres of scattered BLM lands.

Trinidad Ambulance District: The Trinidad Ambulance District was established as a Special District under Colorado law in 1989 and is administered by a five member Board of Directors. In 2006, the voters of Las Animas County approved a general election ballot question that expanded the district's tax base to include all of Las Animas County and established a new lower levy to support the operations.

The Trinidad Ambulance District is based out of two ambulance stations located on the east and west end of Trinidad. The Trinidad Ambulance District provides emergency medical services throughout Las Animas County and they work closely with the volunteer and full-time fire departments, the county Sheriff's Office and the City of Trinidad. All the ambulances are staffed to the level of advanced life support which means there is at least one certified paramedic and emergency medical technician in every ambulance.

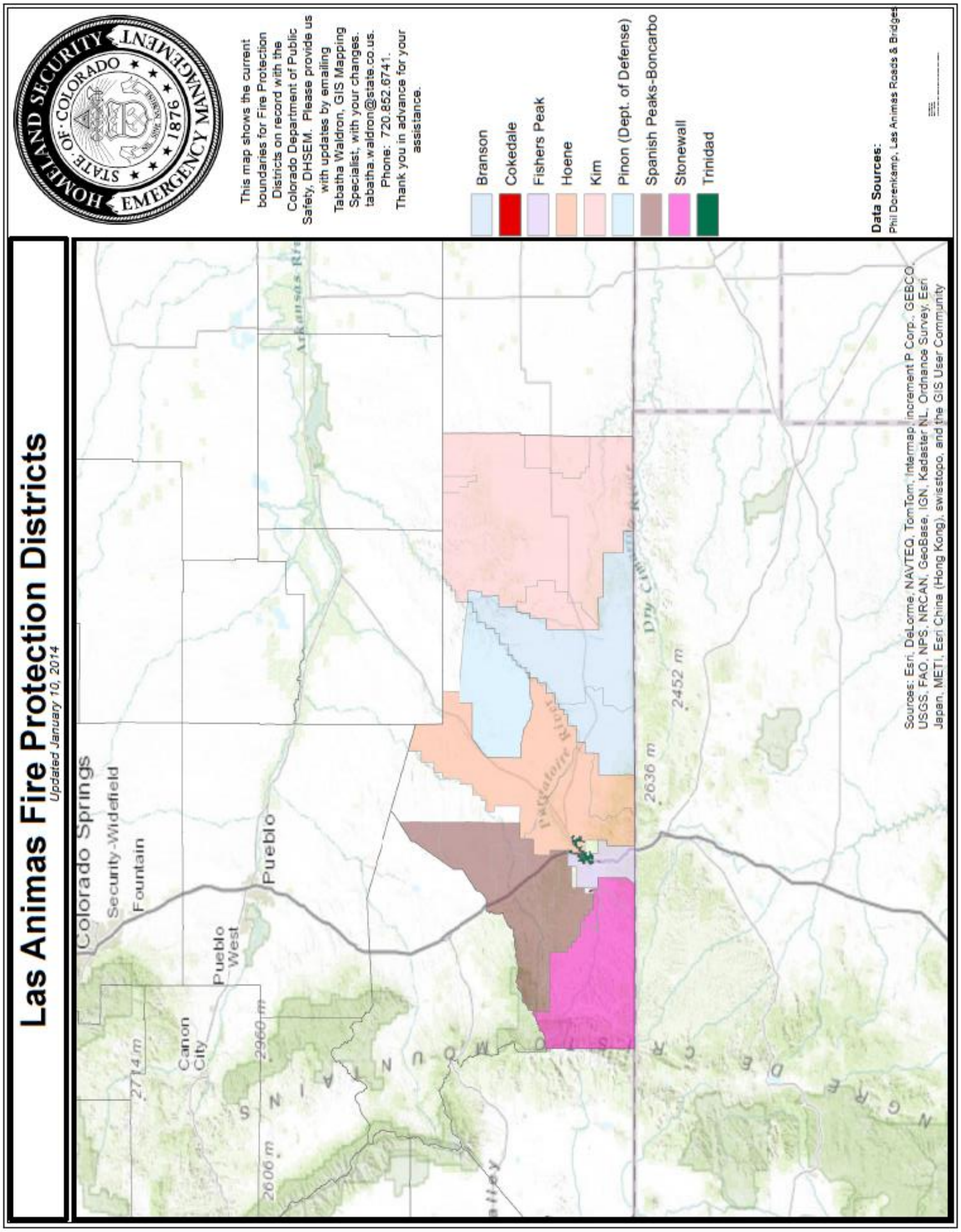


Figure 5-18. Las Animas County Fire Protection Districts

5.9.4 City of Trinidad

The City of Trinidad is governed by a mayor and city council and includes the following departments:

- Building
- City Manager
- City Utilities
- Finance
- Human Resources
- Library
- Municipal Court
- Planning
- Public Safety (Fire and Police)
- Public Works
- Sports and Recreation

Excerpts from applicable policies, regulations, and plans, and descriptions of applicable programs follow to provide more detail on existing mitigation capabilities.

Comprehensive Plan, 2008, update in progress

The 2008 City of Trinidad Comprehensive Plan is a guide for the city government to use in making daily decisions, based on the direction that the community intends to go. The plan promotes health, safety, morals, order, convenience, prosperity, general welfare, efficiency, and economy in the process of city wide development. It details the provisions for organized development, growth management, proper and organized transportation routes, promotion of high-quality civic design and arrangement, and adequate public utilities, facilities, and services. The plan was developed through the combined efforts of the Mayor, City Council, City staff members and citizens of the community.

Under Colorado State Statutes (Sections 30-28-106 and 107), a Comprehensive Plan or “Master” Plan must address, at a minimum, the following issues:

- The general location, character, and extent of the current and desired transportation system.
- The general location and extent of public utilities and terminals to all water, light, power, sanitation, transportation, communication, heat, and other purposes and any anticipated expansion of such utilities.
- An adequate water supply to serve anticipated demand in terms of both quality and quantity.
- Use plans for any dedicated public rights of ways.
- Zoning plans for new development.
- Inventory of available housing, business, and public space and plans for the projected economic and other needs of the current and anticipated population.
- A plan for commercial mineral extraction.
- Demographic projections and associated needs.
- The general location and extent of delicate and hazardous natural areas.

The plan lists the city’s principal issues, directions, policies, and recommendations for actions. The following chapters related to hazard mitigation:

- Chapter 2: Environment and Natural Resources
- Chapter 3: Population and Land Use
- Chapter 6: Plan Direction

Municipal Code, 2009 (as amended), update in progress

The City of Trinidad Municipal Code includes the following chapters and articles applicable to hazard mitigation:

- **Chapter 5 – Buildings:** The City of Trinidad adopted the 2009 version of the following codes: International Building Code, International Fire Code, International Residential Code, International Existing Building Code, International Mechanical Code, International Plumbing Code, International Private Sewage Disposal Code, International Property Maintenance Code, International Fuel Gas Code, and the National Electrical Code. This chapter also includes supplemental regulations to the international building and residential codes.
- **Chapter 8 – Fire Prevention:** The City of Trinidad has adopted the 2009 International Fire Code. This chapter discusses the use and sale of fireworks as well as the penalties for violations.
- **Chapter 12 – Municipal Utilities:** This chapter discusses the ability of the city to adjust water utility rates and impose emergency or conservation restrictions on water use. This chapter also discusses the laws against use or tampering with fire hydrants or other fire suppression systems and wasting water.
- **Chapter 14 – Planning and Zoning:** The City of Trinidad describes their floodplain management standards, zoning specifications, general construction criteria, permits, excavation, etc. for construction activity in Trinidad.

Building Department

The Building Department is dedicated to educate the public by promoting and preserving building safety by the enforcement of minimum codes, and to enhance the relationship with the public and the building community. The Building Inspector is a shared position with Las Animas County and is responsible for inspections of all phases of commercial and residential construction.

Fire Department

The Fire Department operates out of two stations with three pumpers, a ladder truck, and a brush truck to protect the City of Trinidad. The department has specialist certifications that include wildfires response, EMS, HAZMAT, and high-angle rescue.

Planning Department

The Planning Department is responsible to manage all the city's planning efforts. Currently, the Comprehensive Plan, Municipal Codes Plan, and Emergency Operations Plan are being updated.

Public Works Department

The Public Works Department is responsible for engineering, street repair and maintenance, and landfill. The department consists of the following divisions:

- The engineering division performs design and construction management for the city's public works projects and oversees engineering design, construction management inspections to ensure compliance with adopted city codes.
- The street and bridge division is responsible for maintenance of the public right of way that includes the street or alley, traffic signal, the striping, and storm drain system, sweeping, sanding, and snowplowing city streets.
- The landfill division operates the city landfill for all waste including industrial and commercial waste.

Utilities Department

The Utilities Department is responsible for electricity, gas, sewer, and water services for the city.

5.9.5 Town of Aguilar

The Town of Aguilar is governed by a mayor and town board of trustees. The town government is made up of the following offices and departments:

- Marshal
- Planning Commission
- Town Clerk/Treasurer/ Office Manager
- Town Attorney
- Municipal Court Judge
- Utilities Supervisor
- Deputy Clerk/Court Clerk

Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Municipal Code, 2011 (as amended)

Some of the chapters in the Town of Aguilar Municipal Code have provisions related, directly or indirectly, to hazard mitigation. These provisions are mentioned below:

- **Chapter 13 (Municipal Utilities):** This chapter includes information on their municipal departments of natural gas, sewer, and water.
- **Chapter 16 (Zoning):** Regulations are established within the town.
- **Chapter 18 (Buildings Regulations):** This title includes the adoption of 2006 edition of the International Building Code. This title also includes construction design standards and permit requirements for construction.

5.9.6 Town of Cokedale

The Town of Cokedale is governed by a mayor and six town board of trustees. The town government is made up of the following employees:

- Town Clerk/Office Manager
- Code Enforcement
- Maintenance
- Water
- Wastewater
- Volunteer Fire Department

  Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Municipal Codes

The Town of Cokedale's Municipal Codes are cumulative town ordinances and some are related, directly or indirectly, to hazard mitigation.

Fire Department

Cokedale FPD: The Cokedale FPD is very small (located between the Stonewall and Spanish Peaks Bon Carbo FPDs) and it is governed by the Town of Cokedale. There are approximately nine volunteer firefighters. The coverage area includes the town limits and they also respond to mutual aid requests from surrounding fire departments. The FPD mainly responds to grass, forest, structure, and vehicle fires.

5.9.7 Stonewall Fire Protection District

The SFPD was formed in 1949 and became a district in 1999. It is governed by a five-member Board of Directors and is supported by tax revenues from a mill levy on property. The Fire Chief and administrative staff are paid positions with approximately 50 volunteer firefighters, EMTs, and Search and Rescue personnel. There is one tech-level and six operations-level HAZMAT firefighters.

SFPD, located in the western portion of Las Animas County, has 6 fire stations that provides services to approximately 4,000 residents in 547 square miles of WUI. Altitudes range from 6,000 feet to 14,000 feet above mean sea level. Within its district are:

- Over 30 subdivisions and 4 established unincorporated communities (Stonewall, Weston, Seundo, and Valdez)
- Many businesses, including coal and methane gas industry
- Many ranches – large and small
- Resorts and lakes – public and private
- Thousands of acres of undeveloped wildlands

The SFPD is bounded by New Mexico on the south, Costilla County to the west, Huerfano County, and La Veta FPD on the northwest, and the Spanish Peaks/Boncarbo FPD on the east. It includes private land as well as lands owned and/or managed by the BLM, USFS, Colorado State Land Board, and Colorado Parks and Wildlife.

CHAPTER 6.
HAZARD MITIGATION CAPABILITIES ASSESSMENT

The planning team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs and policies, and evaluates its capacity to carry them out.

6.1 LAS ANIMAS COUNTY

6.1.1 Legal and Regulatory Capabilities

Table 6-1 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Las Animas County.

TABLE 6-1.
LAS ANIMAS COUNTY REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive Land Use Plan	Yes	Dated 2001 with 2009 Addendum
Zoning ordinance	Yes	Chapter 3, Las Animas Land Use Regulations
Subdivision ordinance	Yes	Chapter 4, Las Animas Land Use Regulations
Growth management	No	
Floodplain ordinance	Yes	Flood Damage Prevention Resolution
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	An ordinance restricting open fires and use of fireworks. Open fires and use of fireworks are prohibited in the unincorporated areas of Las Animas County.
Building code	Yes	New construction and remodeling for all buildings or structures requires compliance with 2009 International Building Code and International Residential Code standards.
Erosion or sediment control program	No	The county does have a Natural Resources Conservation Service Soil Survey Plan.
Stormwater management	No	
Site plan review requirements	Yes	The County Planning and Zoning Department administers a "Subdivision and/or Planned Unit Development Review" process.
Capital improvement plan	No	
Economic development plan	No	
Local emergency operations plan	In Progress	Las Animas County Emergency Operations Plan

TABLE 6-1. LAS ANIMAS COUNTY REGULATORY MITIGATION CAPABILITIES MATRIX		
Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Other special plans	Yes	Purgatoire Water Conservation Plan and Noxious Weed Plan
Flood insurance study or other engineering study for streams	Yes	Flood Insurance Study for Las Animas County, September 1977. Study includes Flood Insurance Rate Maps and/or Flood Boundary Floodway Maps.
Elevation certificates	Yes	The Las Animas County Floodplain Management and Regulations requires structures and other developments to have an elevation certificate.

6.1.2 Administrative and Technical Capabilities

Table 6-2 identifies the county personnel responsible for activities related to mitigation and loss prevention in Las Animas County.

TABLE 6-2. LAS ANIMAS COUNTYADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX		
Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Department of Land Use/Land Use Officer/ Building Officer
Engineer/professional trained in construction practices related to buildings or infrastructure	Yes	Department of Land Use/Land Use Officer/ Building Officer
Planner/engineer/scientist with an understanding of natural hazards	Yes	Department of Land Use/Land Use Officer/ Building Officer
Personnel skilled in GIS	No	
Full-time building official	No	The position is shared between Las Animas County and the City of Trinidad.
Floodplain manager	Yes	Department of Land Use/Land Use Officer
Emergency manager	Yes	Office of Emergency Management
Grant writer	No	
Other personnel	Yes	Surveyor
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse callback, cable override, outdoor warning signals)	Yes	CodeRed
Other	Yes	Implementing Social Media

TABLE 6-2.
LAS ANIMAS COUNTYADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position

Notes:
GIS Geographic Information System

6.1.3 Financial Capabilities

Table 6-3 identifies financial tools or resources that Las Animas County could use to help fund mitigation activities.

TABLE 6-3.
LAS ANIMAS COUNTY FINANCIAL MITIGATION CAPABILITIES MATRIX

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes with voter approval
Fees for water, sewer, gas, or electric services	No
Impact fees for new development	Only specific permit fees and HB 1041 development permits
Incur debt through general obligation bonds	Yes by voter approval
Incur debt through special tax bonds	Yes by voter approval
Incur debt through private activities	Yes by voter approval
Withhold spending in hazard prone areas	Yes by voter approval
Other	

6.2 CITY OF TRINIDAD

6.2.1 Legal and Regulatory Capabilities

Table 6-4 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Trinidad.

TABLE 6-4.
CITY OF TRINIDAD REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	Yes	City of Trinidad Comprehensive Plan
Zoning ordinance	Yes	Chapter 14, Municipal Code
Subdivision ordinance	Yes	Chapter 14, Municipal Code
Growth management	No	
Floodplain ordinance	Yes	Ordinance No. 1996, Chapter 14, Article 5 Flood Damage Prevention, Effective 12/11/15 (Repealed and Reenacted)
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	
Building code	Yes	City of Trinidad adopted the 2009 International Building Code, Ordinance No. 1949
Erosion or sediment control program	No	
Stormwater management	Yes	Municipal Code
Site plan review requirements	Yes	Municipal Code
Capital improvements plan	Yes	Annual Budget includes a 5-year plan for capital improvements
Economic development plan	Yes	Ordinance in 2015 Economic Development Reserve funds; City funding new for 2016; Director will be hired in 2016
Local emergency operations plan	In progress	
Other special plans		
Flood insurance study or other engineering study for streams	Yes	Flood Insurance Study dated July 1978, adopted Ordinance 1584, eff 5-2-98
Elevation certificates	Yes	

6.2.2 Administrative and Technical Capabilities

Table 6-5 identifies the city personnel responsible for activities related to mitigation and loss prevention in Trinidad.

**TABLE 6-5.
CITY OF TRINIDAD ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX**

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Development Services Director (Planning Dept.)
Engineer/professional trained in construction practices related to buildings or infrastructure	Yes	Contracted as needed
Planner/engineer/scientist with an understanding of natural hazards	Yes	Contracted as needed
Personnel skilled in GIS	Yes	Utilities Superintendent
Full-time building official	No	The position is shared between county and city of Trinidad.
Floodplain manager	Yes	Public Works Director
Emergency manager	Yes	Police Chief
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	Yes	Utilities Superintendent
GIS data: Critical facilities	Yes	Utilities Superintendent
GIS data: Building footprints	Yes	Utilities Superintendent
GIS data: Land use	Yes	Utilities Superintendent
GIS data: Links to Assessor’s data	No	
Warning systems/services (Reverse callback, cable override, outdoor warning signals)	Yes	CodeRed
Other	Yes	Local TV or radio station

Notes:

GIS Geographic Information System

6.2.3 Financial Capabilities

Table 6-6 identifies financial tools or resources that City of Trinidad could use to help fund mitigation activities.

TABLE 6-6.
CITY OF TRINIDAD FINANCIAL MITIGATION CAPABILITIES MATRIX

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	Yes
Incur debt through general obligation bonds	Yes – voter approval
Incur debt through special tax bonds	Yes – voter approval
Incur debt through private activities	No
Withhold spending in hazard prone areas	Yes
Other - Contingency Funds	Yes

6.3 TOWN OF AGUILAR

6.3.1 Legal and Regulatory Capabilities

Table 6-7 lists regulatory and planning tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Town of Aguilar.

TABLE 6-7.
TOWN OF AGUILAR REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	Yes	
Subdivision ordinance	No	
Growth management	No	
Floodplain ordinance	Yes	Ordinance No. 250, signed March 28, 2013
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	
Building code	Yes	2009 International Building Code
Erosion or sediment control program	No	
Stormwater management	No	

TABLE 6-7.
TOWN OF AGUILAR REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Site plan review requirements	Yes	
Capital improvements plan	No	
Economic development plan	No	
Local emergency operations plan	No	
Other special plans	No	
Flood insurance study or other engineering study for streams	Yes	Initial Flood Insurance Rate Map dated July 11, 1975 identified No Special Flood Hazard Area.
Elevation certificates	Yes	

6.3.2 Administrative and Technical Capabilities

Table 6-8 identifies the town personnel responsible for activities related to mitigation and loss prevention in the Town of Aguilar.

TABLE 6-8.
TOWN OF AGUILARADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	No	Part-time, on-call basis
Floodplain manager	Yes	City Clerk
Emergency manager	No	County Emergency Manager
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	

TABLE 6-8.
TOWN OF AGUILARADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse callback, cable override, outdoor warning signals)	No	
Other	Yes	Town Website, Newsletters - every other month

Notes:
GIS Geographic Information System

6.3.3 Financial Capabilities

Table 6-9 identifies financial tools or resources that Town of Aguilar could use to help fund mitigation activities.

TABLE 6-9.
TOWN OF AGUILAR FINANCIAL MITIGATION CAPABILITIES MATRIX

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	No
Authority to levy taxes for specific purposes	No
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	No
Withhold spending in hazard prone areas	No
Other (Stormwater Utility Fees)	No

6.4 TOWN OF COKEDALE

6.4.1 Legal and Regulatory Capabilities

Table 6-7 lists regulatory and planning tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Town of Cokedale.

TABLE 6-10.
TOWN OF COKEDALE REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	Yes	Municipal Code
Subdivision ordinance	Yes	Municipal Code
Growth management	No	
Floodplain ordinance	No	
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	Burn Ban. Open burning prohibited year round.
Building code	Yes	Interjurisdictional agreement with the Las Animas County to use the 2009 International Building Code and International Residential Code standards
Erosion or sediment control program	No	
Stormwater management	Yes	Municipal Code
Site plan review requirements	Yes	Interjurisdictional agreement with Las Animas County Department of Land Use/Land Use Officer/Building Officer
Capital improvements plan	No	
Economic development plan	No	
Local emergency operations plan	Yes	The plan lists wildfire evacuation procedures and chain of command instructions.
Other special plans	No	
Flood insurance study or other engineering study for streams	No	Cokedale does not participate in the NFIP
Elevation certificates	No	

Notes:
NFIP National Flood Insurance Program

6.4.2 Administrative and Technical Capabilities

Table 6-8 identifies the Town personnel responsible for activities related to mitigation and loss prevention in the Town of Cokedale.

TABLE 6-11.
TOWN OF COKEDALE ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Interjurisdictional agreement with Las Animas County Department of Land Use/Land Use Officer/Building Officer, City of Trinidad, fire departments, hire a contractor
Engineer/professional trained in construction practices related to buildings or infrastructure	Yes	Interjurisdictional agreement with Las Animas County Department of Land Use/Land Use Officer/Building Officer, hire a contractor, contact Colorado Department of Local Affairs
Planner/engineer/scientist with an understanding of natural hazards	No	Colorado Department of Local Affairs and other state agencies
Personnel skilled in GIS	No	
Full-time building official	No	
Floodplain manager	No	
Emergency manager	Yes	Town Clerk, then assistance from county emergency manager
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse callback, cable override, outdoor warning signals)	Yes	One outdoor warning siren, and implement Trinidad's CodeRed System
Other		

Notes:

GIS Geographic Information System

6.4.3 Financial Capabilities

Table 6-9 identifies financial tools or resources that Town of Cokedale could use to help fund mitigation activities.

TABLE 6-12.
TOWN OF COKEDALE FINANCIAL MITIGATION CAPABILITIES MATRIX

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes, upon voter approval.
Fees for water, sewer services	Yes, upon voter approval.
Impact fees for new development	Yes, upon voter approval.
Incur debt through general obligation bonds	Yes, upon voter approval.
Incur debt through special tax bonds	Yes, upon voter approval.
Incur debt through private activities	Yes, upon voter approval.
Withhold spending in hazard prone areas	Yes, upon voter approval.
Other (Stormwater Utility Fees)	Yes, upon voter approval.

6.5 STONEWALL FIRE PROTECTION DISTRICT

The SFPD is governed by a five-member Board of Directors and is supported by tax revenues from a mill levy on property. The Fire Chief and administrative staff are paid positions with approximately 50 volunteer firefighters, EMTs, and search and rescue personnel. There is one tech-level and six operations-level HAZMAT firefighters.

As stated in Section 5.9.3, the SFPD has a CWPP, November 2014 that details their firefighting capabilities, station equipment, as well as their current risk situation for wildfire and interface with structures.

6.6 SUMMARY OF CAPABILITIES ASSESSMENT

The capabilities assessment identifies the plans, regulations, personnel, and funding mechanisms available to the county, participating communities, and fire protection district to impact and mitigate the effects of natural hazards. Las Animas County as well as the three participating communities strive to find the appropriate balance between regulatory authority and private property owners' rights.

Las Animas County has plans and programs in place to directly and indirectly address emergency management and the implementation of a proactive hazard mitigation plan. These plans include the County Comprehensive Land Use Plan, three independent CWPP, and specific programs, such as the Noxious Weed Program. It should be noted that while many of the plans address erosion control and economic development, the county does not have separate erosion control nor economic development plans. While the BOCC and the county emergency manager (working under the BOCC) have primary responsibility for the implementation of the hazard mitigation plan, it takes cooperation and coordination on the part of all county departments to successfully implement the mitigation plan. In addition to the county's part-time emergency manager, the county has a Land Use Department with a building officer position that is shared with the City of Trinidad, and other departments to coordinate the planning, mitigation, and response to natural hazard events. The county enforces the 2009 IBC and IRC and uses CodeRed as a public warning system. In addition to the traditional FEMA funding mechanisms, the county can obtain funds for hazard mitigation projects through community development block grants, capital improvement project funds, taxes, and can incur debt by voter approval.

The City of Trinidad has a comprehensive plan, municipal codes, and land use codes that direct development within the municipality; the Towns of Aguilar and Cokedale have zoning ordinances for their municipality. All participating municipalities have adopted the 2009 International Building Code and have codes and ordinances in place that restrict the development of land within hazard areas, such as floodplains. These plans and codes provide a framework for future ordinances and programs to further mitigate natural hazard events. The City of Trinidad, as the largest municipality in the county, has more administrative and technical capabilities than the Towns of Aguilar and Cokedale, including planning and building and public works departments. The City of Trinidad has identified the Police Chief as the emergency manager. The Town of Aguilar emergency management is coordinated with the County OEM. The Town of Cokedale has identified the Town Clerk as the emergency manager. The Towns of Aguilar and Cokedale have limited access to fund mitigation actions through grants, bonds, taxes, or fees per voter approval. While the SFPD is supported by tax revenues from a mill levy on property.

While the capabilities of Las Animas County and the planning partners within are strong, there is opportunity to strengthen their abilities to proactively mitigate natural hazards in the community through the expansion of existing department staffs as well as the creation and hiring of new departments and staff, for example, an economic development director. However, like most communities within the region, Las Animas County, Trinidad, Aguilar, and Cokedale are all challenged with similar financial constraints – not enough funding for all potential positions. Consideration can be given as to whether there is grant funding or funding from other non-traditional sources available to fund positions and activities in the future.

PART 2— RISK ASSESSMENT

CHAPTER 7.
AVALANCHE

AVALANCHE HAZARD RANKING	
Las Animas County	Low
City of Trinidad	Low
Town of Aguilar	No Exposure
Town of Cokedale	Low
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

7.1 GENERAL BACKGROUND

Avalanches can occur whenever a sufficient depth of snow is deposited on slopes steeper than approximately 20 degrees, with the most dangerous coming from slopes in the 35- to 40-degree range. Avalanche-prone areas can be identified with some accuracy, since they typically follow the same paths year after year, leaving scarring on the paths. However, unusual weather conditions can produce new paths or cause avalanches to extend beyond their normal paths.

In the spring, warming of the snowpack occurs from below (from the warmer ground) and above (from warm air, rain, etc). Warming can be enhanced near rocks or trees that transfer heat to the snowpack. The effects of a snowpack becoming weak may be enhanced in steeper terrain where the snowpack is shallow, and over smooth rock faces that may focus meltwater and produce "glide cracks." Such slopes may fail during conditions that encourage melt.

Wind can affect the transfer of heat into the snowpack and associated melt rates of near-surface snow. During moderate to strong winds, the moistening near-surface air in contact with the snow is constantly mixed with drier air above through turbulence. As a result, the air is continually drying out, which enhances evaporation from the snow surface rather than melt. Heat loss from the snow necessary to drive the evaporation process cools off near-surface snow and results in substantially less melt than otherwise might occur, even if temperatures are well above freezing.

When the snow surface becomes uneven in spring, air flow favors evaporation at the peaks, while calmer air in the valleys favors condensation there. Once the snow surface is wet, its ability to reflect solar energy drops dramatically; this becomes a self-perpetuating process, so that the valleys deepen (favoring calmer air and more heat transfer), while more evaporation occurs near the peaks, increasing the differential between peaks and valleys. However, a warm wet storm can quickly flatten the peaks as their larger surface area exposed to warm air, rain or condensation hastens their melt over the sheltered valleys.

DEFINITIONS

Avalanche—Any mass of loosened snow or ice and/or earth that suddenly and rapidly breaks loose from a snowfield and slides down a mountain slope, often growing and accumulating additional material as it descends.

Slab avalanches—The most dangerous type of avalanche, occurring when a layer of coherent snow ruptures over a large area of a mountainside as a single mass. Like other avalanches, slab avalanches can be triggered by the wind, by vibration, or even by a loud noise, and will pull in surrounding rock, debris, and even trees.

Climax avalanches—An avalanche involving multiple layers of snow, usually with the ground as a bed surface.

Loose snow avalanches—An avalanche that occurs when loose, dry snow on a slope becomes unstable and slides. Loose snow avalanches start from a point and gather more snow as they descend, fanning out to fill the topography.

Powder snow avalanches—An avalanche that occurs when sliding snow has been pulverized into powder, either by rapid motion of low-density snow or by vigorous movement over rugged terrain.

Surface avalanches—An avalanche that occurs only in the uppermost snow layers.

Wet snow avalanche—An avalanche in wet snow, also referred to as a wet loose avalanche or a wet slab avalanche. Often the basal shear zone is a water-saturated layer that overlies an ice zone.

Avalanches can reach speeds of up to 200 miles per hour (mph) and can exert forces great enough to destroy structures and uproot or snap off large trees. Avalanche paths consist of a starting zone, a track, and a runout zone. The runout zone is often an attractive setting for development.

According to Colorado Avalanche Information Center (CAIC), avalanches have killed more people in Colorado than any other natural hazard since 1950, and Colorado accounts for one-third of all avalanche deaths in the United States (CAIC no date). Avalanche forecasts were first issued by the Colorado Avalanche Warning Center in 1973. The program was originally part of a federal research program, but has been a part of the Colorado State government since 1983. The CAIC is now a program within the Colorado Department of Natural Resources, Executive Director's Office. The program is a partnership between the Colorado Department of Natural Resources, Colorado Department of Transportation (CDOT), and the Friends of the CAIC (FoCAIC) a 501(c)3 group. The mission of the CAIC is to provide avalanche information and education and to promote research for the protection of life, property, and the enhancement of the state's economy (CAIC no date).

7.2 HAZARD PROFILE

7.2.1 Past Events

Although infrequent, avalanches do occur periodically in the county in non-populated areas. Generally, avalanches in Las Animas County are relatively minor. There have not been any recorded property damages or fatalities attributable to avalanches in Las Animas County.

7.2.2 Location

A portion of Las Animas County has a slope greater than 20 percent and therefore is considered to have low to moderate risk of an avalanche.

There is no mapped avalanche risk zone information available for Las Animas County; however, a slope analysis was performed in order to identify areas that may potentially be at risk for an avalanche event. Figure 7-1 shows slopes in the county that are greater than 20 degrees.

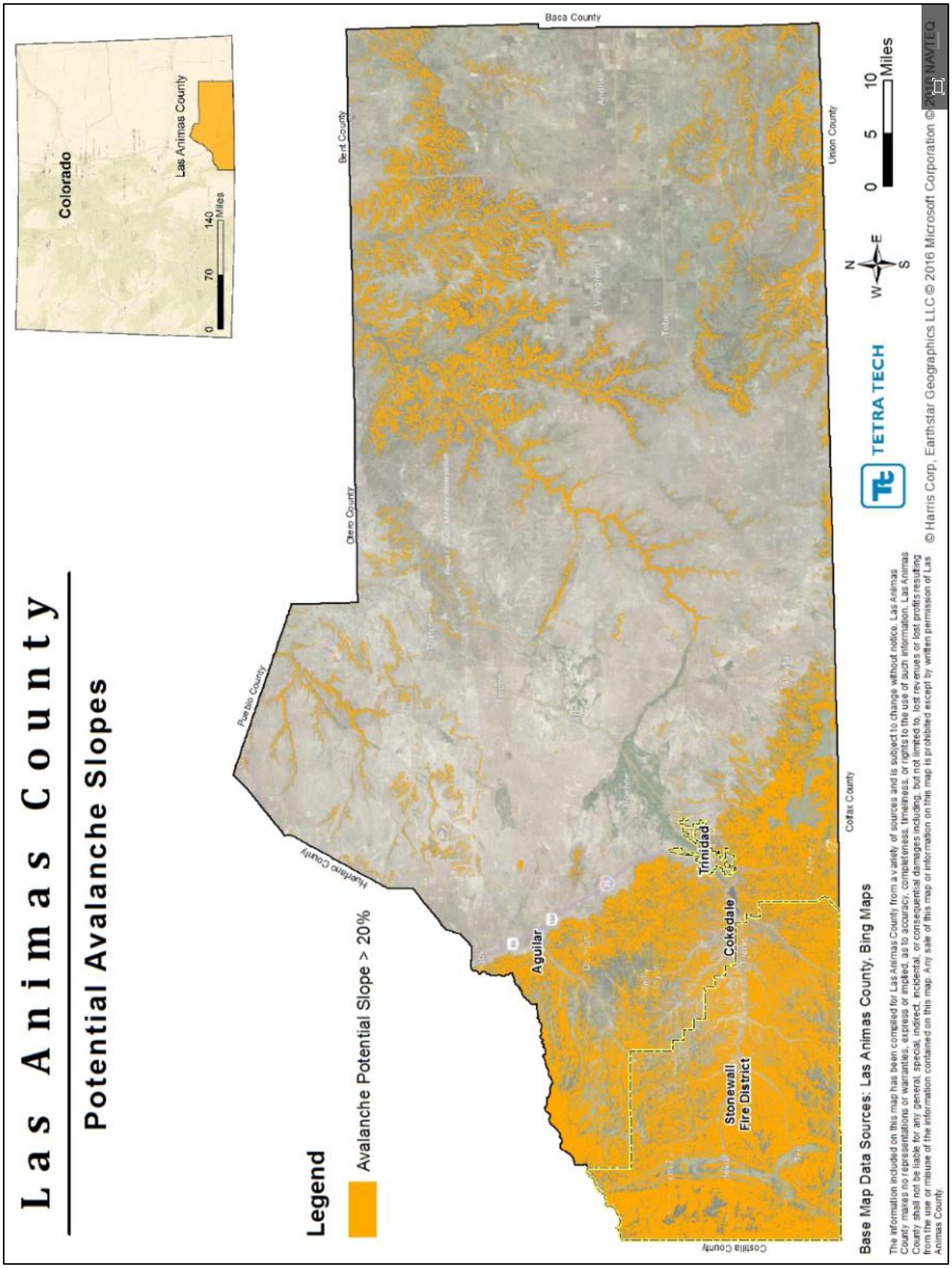


Figure 7-1. Avalanche Potential in Las Animas County

7.2.3 Frequency and Severity

The probability of an avalanche occurring in the future is low for the county and was considered as such by the Steering Committee. Avalanche probability for the City of Trinidad, the Town of Cokedale and the Stonewall Fire Protection District (SFPD) are relatively low. The Town of Aguilar has no exposure. The risk to recreational users in the backcountry can be higher because of higher potential for avalanches.

A number of weather and terrain factors determine avalanche severity and danger:

Weather:

- Storms—A large percentage of all snow avalanches occur during and shortly after storms.
- Rate of snowfall—Snow falling at a rate of 1 inch or more per hour rapidly increases avalanche danger.
- Temperature—Storms starting with low temperatures and dry snow, followed by rising temperatures and wetter snow, are more likely to cause avalanches than storms that start warm and then cool with snowfall.
- Wet snow—Rainstorms or spring weather with warm, moist winds and cloudy nights can warm the snow cover, resulting in wet snow avalanches. Wet snow avalanches are more likely on sun-exposed terrain (south-facing slopes) and under exposed rocks or cliffs.

Terrain:

- Ground cover—Large rocks, trees, and heavy shrubs help anchor snow.
- Slope profile—Dangerous slab avalanches are more likely to occur on convex slopes.
- Slope aspect—Leeward slopes are dangerous because windblown snow adds depth and creates dense slabs. South-facing slopes are more dangerous in the springtime.
- Slope steepness—Snow avalanches are most common on slopes of 30 to 45 degrees.

The common factors contributing to the avalanche hazard are old snow depth, old snow surface, new snow depth, new snow type, density, snowfall intensity, precipitation intensity, settlement, wind direction and speed, temperature, and subsurface snow crystal structure.

According to the CAIC an average of 28 people have died each year in avalanches in the United States over the past 10 winters. Most fatal incidents are investigated and reported; however, non-fatal incidents are likely to go unreported (CAIC no date). Colorado has recorded the greatest number of fatalities due to avalanches of all states in the United States, as shown in Figure 7-2.

The severity of the avalanche hazard in the county is considered to be low since there are no recorded deaths and injuries; no property damage; and or no interruption of essential facilities and services. Based on the information in this hazard profile, the magnitude/severity of an avalanche, and its overall significance is considered to have a low potential impact for the county. The magnitude/severity of an avalanche for the jurisdictions is minimal.

*Source: Colorado Avalanche Information Center Website (*http://avalanche.state.co.us/accidents/statistics-and-reporting/*)*

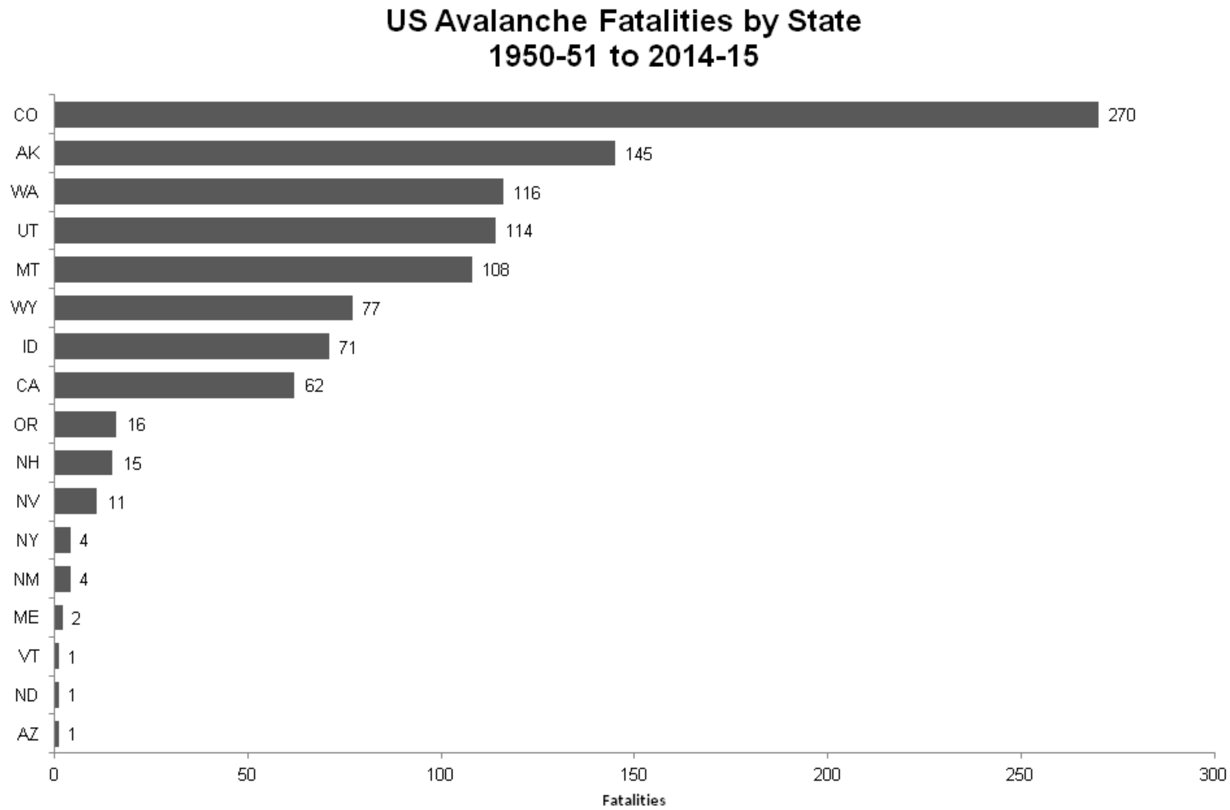


Figure 7-2. Avalanche Fatalities by State, 1950/1951 to 2014/2015

7.2.4 Warning Time

The time of an avalanche release depends on the condition of the snow pack; which can change rapidly during a day and particularly during rainfall. Although forecasts can provide information regarding when avalanches are more likely to occur, an avalanche can occur with little or no warning time.

CAIC issues watches and warnings by zone to communicate avalanche danger levels to those recreating in backcountry areas. The North American Danger Scale, which ranges from low to extreme danger is shown in Figure 7-3. An example of this forecast for the Front Range area is shown in Figure 7-4.

Source: Colorado Avalanche Information Center Website (http://avalanche.state.co.us/wp-content/uploads/2013/09/ads.jpg.)

North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size and distribution of avalanches.

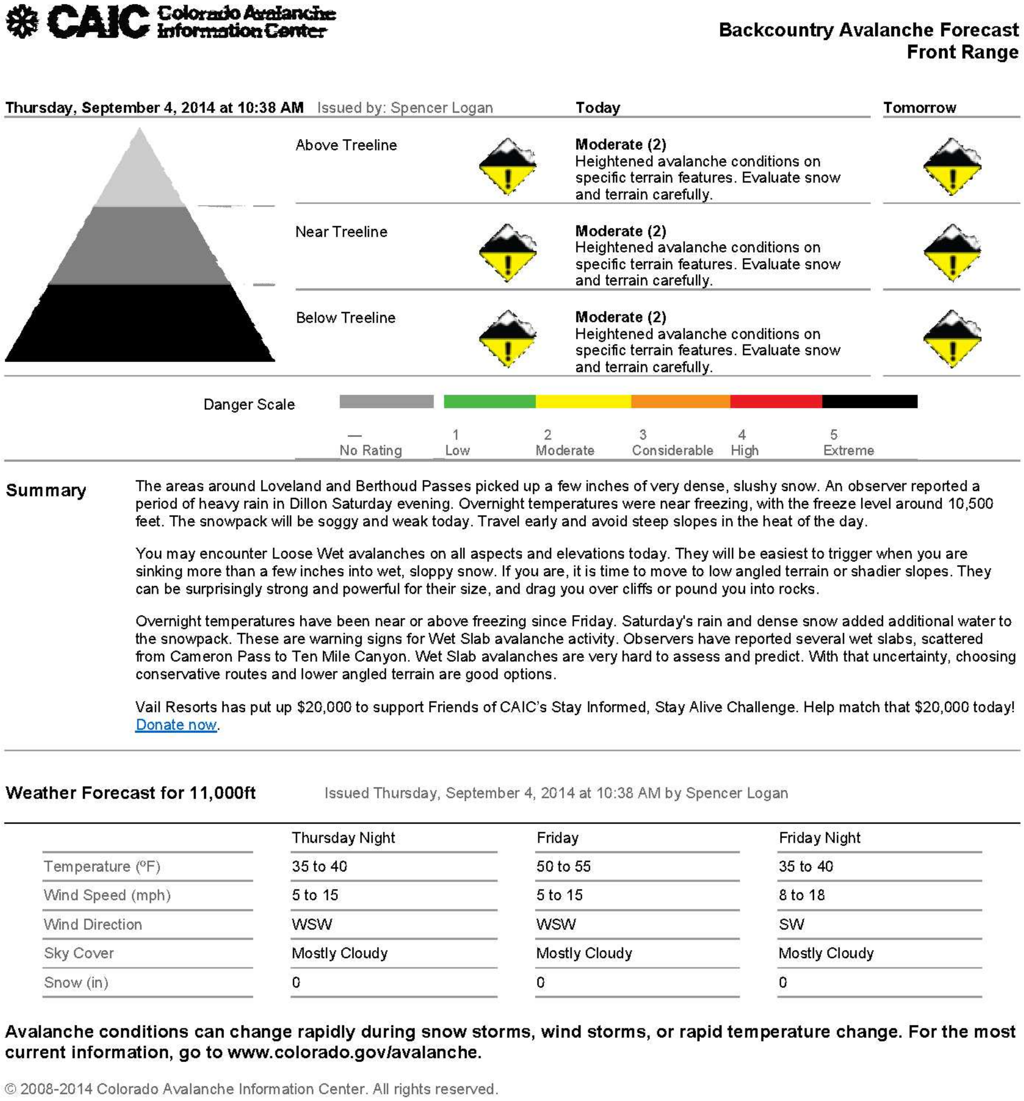
Danger Level		Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme	4 5	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High	4 5	Very dangerous avalanche conditions. Travel in avalanche terrain <u>not</u> recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable	3	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate	2	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low	1	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

No Rating		Insufficient information to establish avalanche danger rating. Check zone forecast for local information.

Figure 7-3. Avalanche Danger Scale

Source: Colorado Avalanche Information Center Website (http://avalanche.state.co.us/forecasts/backcountry-avalanche/front-range/)



CAIC Colorado Avalanche Information Center

Backcountry Avalanche Forecast
Front Range

Thursday, September 4, 2014 at 10:38 AM Issued by: Spencer Logan

	Today	Tomorrow
Above Treeline	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.	
Near Treeline	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.	
Below Treeline	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.	

Danger Scale

— No Rating; 1 Low; 2 Moderate; 3 Considerable; 4 High; 5 Extreme

Summary

The areas around Loveland and Berthoud Passes picked up a few inches of very dense, slushy snow. An observer reported a period of heavy rain in Dillon Saturday evening. Overnight temperatures were near freezing, with the freeze level around 10,500 feet. The snowpack will be soggy and weak today. Travel early and avoid steep slopes in the heat of the day.

You may encounter Loose Wet avalanches on all aspects and elevations today. They will be easiest to trigger when you are sinking more than a few inches into wet, sloppy snow. If you are, it is time to move to low angled terrain or shadier slopes. They can be surprisingly strong and powerful for their size, and drag you over cliffs or pound you into rocks.

Overnight temperatures have been near or above freezing since Friday. Saturday's rain and dense snow added additional water to the snowpack. These are warning signs for Wet Slab avalanche activity. Observers have reported several wet slabs, scattered from Cameron Pass to Ten Mile Canyon. Wet Slab avalanches are very hard to assess and predict. With that uncertainty, choosing conservative routes and lower angled terrain are good options.

Vail Resorts has put up $20,000 to support Friends of CAIC's Stay Informed, Stay Alive Challenge. Help match that $20,000 today! Donate now.

Weather Forecast for 11,000ft Issued Thursday, September 4, 2014 at 10:38 AM by Spencer Logan

	Thursday Night	Friday	Friday Night
Temperature (ºF)	35 to 40	50 to 55	35 to 40
Wind Speed (mph)	5 to 15	5 to 15	8 to 18
Wind Direction	WSW	WSW	SW
Sky Cover	Mostly Cloudy	Mostly Cloudy	Mostly Cloudy
Snow (in)	0	0	0

Avalanche conditions can change rapidly during snow storms, wind storms, or rapid temperature change. For the most current information, go to www.colorado.gov/avalanche.

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Figure 7-4. Sample Front Range Avalanche Danger Forecast

7.3 SECONDARY HAZARDS

Avalanches can cause several types of secondary effects, such as blocking roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from avalanches are power and communication failures. Avalanches also can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

7.4 CLIMATE CHANGE IMPACTS

Unlike other phenomena such as tropical storms, snow avalanches are rarely used as indicators of climate change. The effects of climate change on avalanche frequency and magnitude are uncertain and will likely be dependent on local climate change impacts, such as changes in snow fall events and temperature series. Some studies have indicated that the types of avalanche events (wet or dry) may shift as a result of changes in snow cover (Martin et al. 2001). Avalanches, however, are not influenced by snow cover alone, but several interrelated factors including forest structure, surface energy balance, melt water routing, precipitation, air temperature, and wind (Teich et al. 2012; Eckert 2009; and Lazar and Williams 2008).

Secondary and tertiary impacts of climate change may also alter avalanche events. For example, climate change may modify the distribution of arboreal species across mountain landscapes. Some case studies in the Swiss and French Alps indicate that climate change impacts may reduce the frequency or severity of such events, while other assessments indicate that events may occur more frequently in other mountain regions (Kohler 2009; Teich et al. 2012; and Eckert 2009). No studies assessing the relative frequency and severity of avalanches in the Colorado Rocky Mountain Range were located, but an analysis of wet avalanche hazards in an Aspen ski area indicated that such effects may occur more frequently under high emissions scenarios (Lazar and Williams 2008). Feedback loops affecting snow cover, forest structure, meteorological norms, and land use planning decisions are all likely to influence the future frequency and severity of impacts from avalanche events.

7.5 EXPOSURE

Mountain communities are exposed to avalanche risk; however, the greatest exposure to the avalanche hazard is to persons participating in outdoor recreation in backcountry areas. Transportation routes, including Colorado State Highway 12 have exposure to avalanches. CDOT monitors and controls 278 of 522 known avalanche paths in Colorado. According to their website "When there is a high risk of avalanche danger, CDOT will close highways at the location of the avalanche path in order to conduct avalanche control. Once all the unstable snow has been brought down, CDOT crews have to clear all of the snow and debris from the roadway before reopening the highway to traffic. Since it is impossible to predict how much snow will be brought down during a control mission, CDOT cannot estimate how long a highway closure will be in place. CDOT will open the highway as soon as it is safe for the traveling public" (CDOT no date).

7.5.1 Population

The greatest impact from an avalanche is to mountain communities in the Sangre de Cristo Mountains as well as State Highway 12. However, avalanches are also a danger to hikers, mountain bike riders, and others involved in outdoor sports in these areas. The populations of the City of Trinidad, and the Towns of Aguilar and Cokedale are unlikely to be affected by avalanches.

7.5.2 Property

Avalanche exposure in the county is minimal. Property and buildings within runout areas are exposed, but of the approximate 8,224 buildings in Las Animas County, most are not in avalanche runout areas. Property located within the jurisdictions of the county are located in valley regions and are not at high risk for property damage because of avalanche events.

7.5.3 Critical Facilities and Infrastructure

It is unlikely that there are critical facilities exposed to avalanche hazards, although there may be some facilities exposed in mountain communities. There is a small amount of road infrastructure that could be blocked by avalanches, such as State Highway 12.

7.5.4 Environment

Avalanches are a natural event, but they can negatively affect the environment. This includes trees located on steep slopes. A large avalanche can knock down many trees and kill the wildlife that live in them. In spring, this loss of vegetation on the mountains may weaken the soil, causing landslides and mudflows.

7.6 VULNERABILITY

In general, everything that is exposed to an avalanche event is vulnerable. As more people work, build, and recreate in mountain communities, there will be more people exposed to avalanche hazard areas. These individuals may have little experience with, caution regarding, or preparation for avalanche conditions. The increasing development of recreational sites in the mountains brings added exposure to the people using these sites and the access routes to them. The risk to human life is especially great at times of the year when rapid warming follows heavy, wet snowfall.

The major issues of concern in the event of an avalanche are the threat to recreational users and property and the possibility of disruptions to the electrical grid network. According to CDOT during the 2011-2012 winter there were 332 hours of road closures due to avalanche control, resulting in a total of 13,221 feet of snow covering the centerline of the roadway. These roads were closed a total of 370 hours. There is no effective way to keep the public out of avalanche-prone recreational areas, even during times of highest risk. A coordinated effort is needed among state, county, and local law enforcement, fire, emergency management, public works agencies and media to better provide winter snow pack and avalanche risk information to the public.

7.7 FUTURE TRENDS IN DEVELOPMENT

Future trends in development cannot be determined until the avalanche hazard areas are accurately mapped. The population of Las Animas County is increasing and some of this new development may be occurring in avalanche hazard areas.

7.8 SCENARIO

In a worst-case scenario, an avalanche would occur in the Sangre de Cristo Mountains after a series of storms. Storms starting with low temperatures and dry snow, followed by rising temperatures and wetter snow, are more likely to cause avalanches than storms that start warm and then cool with snowfall.

7.9 ISSUES

A national program to rate avalanche risk has been developed to standardize terminology and provide a common basis for recognizing and describing hazardous conditions. The avalanche danger scale relates degree of avalanche danger (low, moderate, considerable, high, extreme) to descriptors of avalanche probability and triggering mechanism, degree and distribution of avalanche hazard, and recommended action in backcountry. Avalanche danger scale information should be explained to the public and made available through appropriate county and local agencies and the media.

Measures that have been used in other jurisdictions to reduce avalanche threat include monitoring timber harvest practices in slide-prone areas to ensure that snow cover is stabilized as well as possible, and encouraging reforestation in areas near highways, buildings, power lines, and other improvements. The development of a standard avalanche report form, and the maintenance of a database of potential avalanche hazards likely to affect proposed developments in mountain wilderness areas, would be of significant value to permitting agencies.

CHAPTER 8. DAM/LEVEE FAILURE

DAM/LEVEE FAILURE HAZARD RANKING	
Las Animas County	Medium
City of Trinidad	Medium
Town of Aguilar	Low
Town of Cokedale	Low
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Dam—A man-made barrier, together with appurtenant structures, constructed above the natural surface of the ground for the purpose of impounding water. Flood control and storm runoff detention dams are included (2-CCR 402-1, Rule 4, Section 4.2.5).

Dam Failure—An uncontrolled release of impounded water due to structural deficiencies in dam.

Emergency Action Plan—A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

High Hazard Dam—Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Significant Hazard Dam—Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

Levee—A man-made structure, usually an earthen embankment or concrete floodwall, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide reasonable assurance of excluding temporary flooding from the leveed area.

8.1 GENERAL BACKGROUND

8.1.1 Causes of Dam Failure

Dam failures in the United States typically occur in one of four ways:

- Overtopping of the primary dam structure, which accounts for 34% of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30% of all dam failures.
- Failure due to piping and seepage accounts for 20% of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10% of all failures.

The remaining 6% of dam failures in the United States are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

8.1.2 Causes of Levee Failure

The following information is excerpted from the *2013 State of Colorado Natural Hazards Mitigation Plan*. The Hazards, United States-Multi Hazard (HAZUS-MH) database and the U.S. Army Corps of Engineers (USACE) National Levee Database list no known levees in Las Animas County. It is possible that there are levees located within the county that are not listed in these databases.

A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure. Unfortunately, in the rare occurrence when a levee system fails or is overtopped, severe flooding can occur due to increased elevation differences associated with levees and the increased water velocity that is created. It is also important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure. In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the amount of water.

The complicated nature of levee protection was made evident by events such as Hurricane Katrina. Flooding can be exacerbated by levees that are breached or overtopped. As a result, the Federal Emergency Management Agency (FEMA) and the USACE are re-evaluating their policies regarding enforcement of levee maintenance and post-flood rebuilding. Both agencies are also conducting stricter inspections to determine how much protection individual levees actually provide. The Colorado Water Conservation Board (CWCB) is committed to aiding local governments with the increased levels of compliance with federal regulations. CWCB will assist qualifying entities who are in good standing with the National Flood Insurance Program (NFIP) through technical and financial assistance. CWCB assistance may include grant funding, participation in levee inspections, assistance in developing Maintenance Deficiency Correction Plans, site visits, and participation in public hearings. In addition, the CWCB will also discourage the construction of new levees to protect new developments, and instead encourage other types of flood mitigation projects.

8.1.3 Regulatory Oversight

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

Colorado Rules and Regulations for Dam Safety and Dam Construction

The *Colorado Rules and Regulations for Dam Safety and Dam Construction* (2-Code of Colorado Regulations [CCR] 402-1, January 1, 2007) apply to any dam constructed or used to store water in Colorado. These rules apply to applications for review and approval of plans for the construction, alteration, modification, repair, enlargement, and removal of dams and reservoirs, quality assurance of construction, acceptance of construction, non-jurisdictional dams, safety inspections, owner responsibilities, emergency action plans, fees, and restriction of recreational facilities within reservoirs. Certain structures (defined in Rule 17) are exempt from these rules. The purpose of the rules is to provide for the public safety through the Colorado Safety of Dams Program by establishing reasonable standards and to create a public record for reviewing the performance of a dam.

Colorado Department of Natural Resources, Division of Water Resources, Dam Safety Branch

The Dam Safety Branch has oversight of more than 1,800 non-federally owned dams in the state and it focuses its regulatory activities on dams that are referred to as jurisdictional size dams. Jurisdictional size dams are those that create a reservoir with a capacity of more than 100 acre-feet, have a surface area in excess of 20 acres at the high-water line, or exceed 10 feet in height, according to 2 CCR 402.1, Rule 4.2.5. The Dam Safety Branch's mission is to conduct two primary functions: (1) review and approve design for new dams and modification of existing dams, and (2) periodically inspect and analyze dam conditions including dam owners' emergency planning.

U.S. Army Corps of Engineers Dam Safety Program

The USACE is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The USACE has inventoried dams; surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety (USACE 1997).

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license

Every 5 years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

8.2 HAZARD PROFILE

8.2.1 Past Events

Colorado has a history of dam failure, with more than 130 known dam failures since 1890. A number of dams were breeched in September 2013, but none were in Las Animas County. According to the *State Engineer's 27th Annual Report on Dam Safety to the Colorado General Assembly Fiscal Year 2010-11 and 2011-12*, no jurisdictional dam failures occurred in Colorado in water year 2010-2011 or water year 2011-2012. Fourteen dam safety incidents were logged for the same time period statewide. Dam safety incidents are defined as situations at dams that require an immediate response by dam safety engineers.

Incidents also included on the water year 2011-2012 list were associated with the large and damaging wildfires that occurred, particularly the High Park Fire and the Waldo Canyon Fire. These fires were tracked to ensure no damage would occur on dams within or near the fire areas.

According to the Association of State Dam Safety Officials, there have been no reported dam failures in Las Animas County.

8.2.2 Location

Data about dams is compiled by the Colorado Division of Water Resources Dam Safety. The data lists 40 dams in the county and classifies dams based on the potential hazard to the downstream area resulting from failure or mis-operation of the dam or facilities:

- **High Hazard Potential**—Probable loss of life (one or more)
- **Significant Hazard Potential**—No probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns; often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure
- **Low Hazard Potential**—No probable loss of human life and low economic or environmental losses; losses are principally limited to the owner's property

Based on these classifications, there are 7 high hazard dams and 33 low hazard dams in Las Animas County. The high hazard dams are listed in Table 8-1 with the downstream city impact, the maximum storage capacity, and the date of the latest revised emergency action plan.

**TABLE 8-1.
HIGH AND SIGNIFICANT HAZARD DAMS IN LAS ANIMAS COUNTY**

Name	River	Downstream City	Town Distance (Miles)	Max Storage (Acre-Feet)	Hazard Class	Date of Emergency Action Plan
Apishapa Dam	Apishapa	Aguilar	10	209	High	8/04/1995
Fisher Peak Detention Dam FPC 1	Purgatoire	Trinidad	0	274	High	7/01/2014
Fisher Peak Detention Dam FPC 2	Purgatoire	Trinidad	0	94	High	7/01/2014
Monument Lake Dam	Cherry Creek	Monument Park	0	1,511	High	8/15/2014
North Lake Dam	Coal Creek	Vigil	6	4,276	High	3/09/2015
Pinon Canyon Dam	Pinon Canyon	Trinidad	0	406	High	7/01/2014
Trinidad Dam	Purgatoire	Trinidad	1	119,877	High	4/01/2016

Source: Colorado Division of Water Resources

Figure 8-1 through Figure 8-3 show locations of the high-potential-loss dams in the county and the locations of critical facilities and infrastructure within the dam inundation areas. The areas of the county most likely to be impacted by a dam failure are along the Purgatoire River. Four high hazard dams could impact the City of Trinidad.

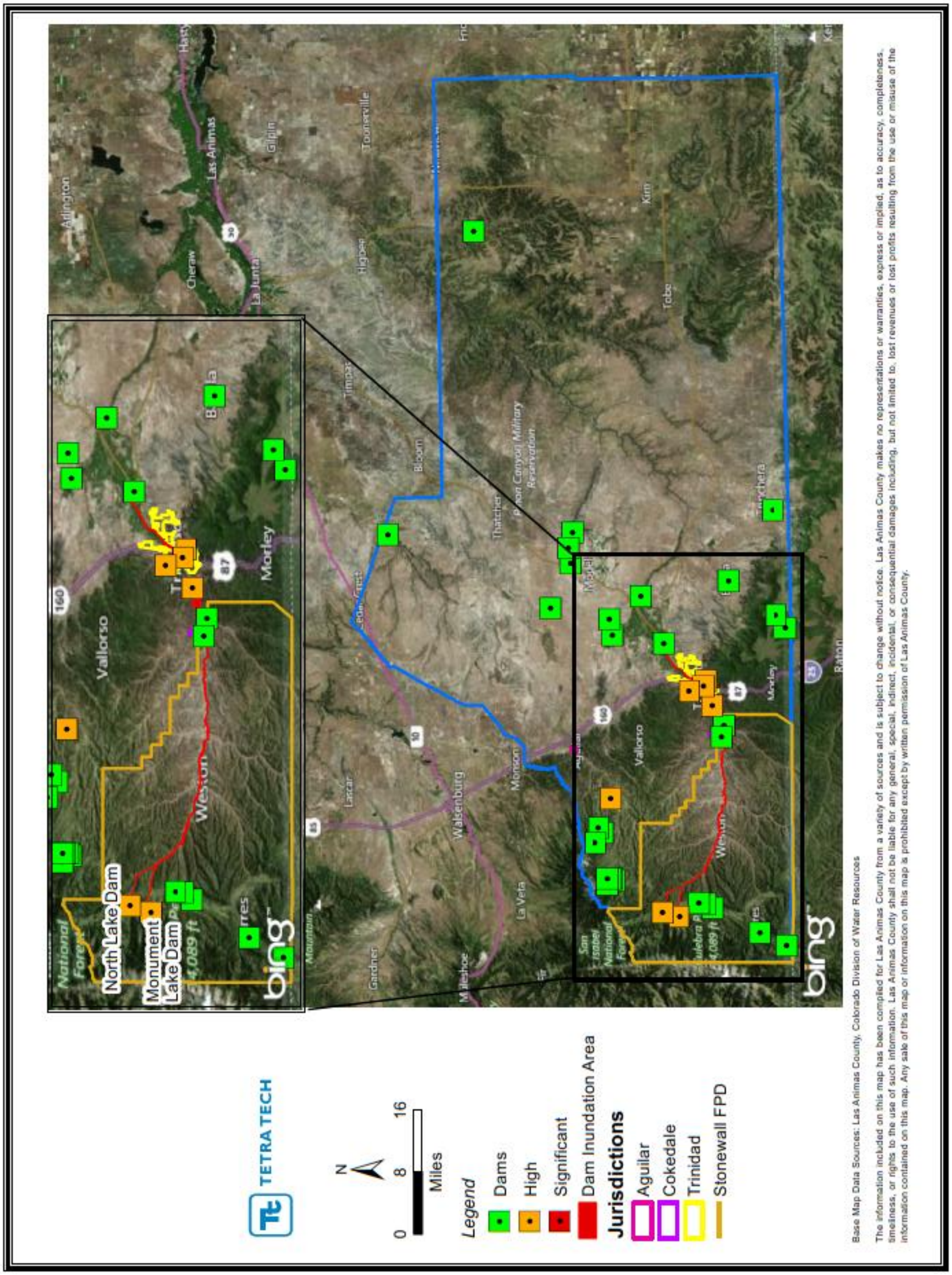


Figure 8-1. Dams Within and Upstream of Las Animas County and Dams with Known Inundation Areas

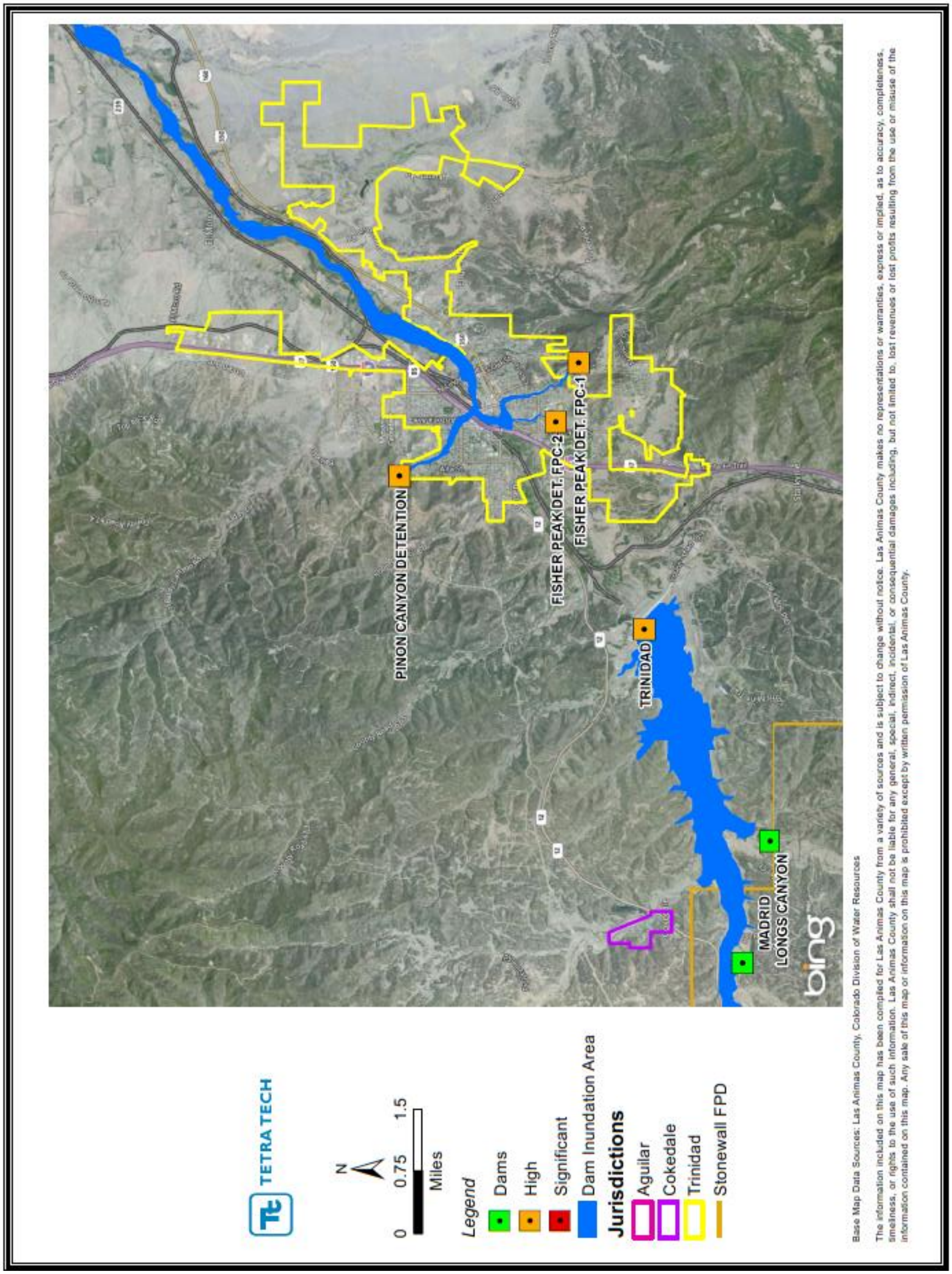


Figure 8-2. Dams and Inundation Areas Impacting the City of Trinidad

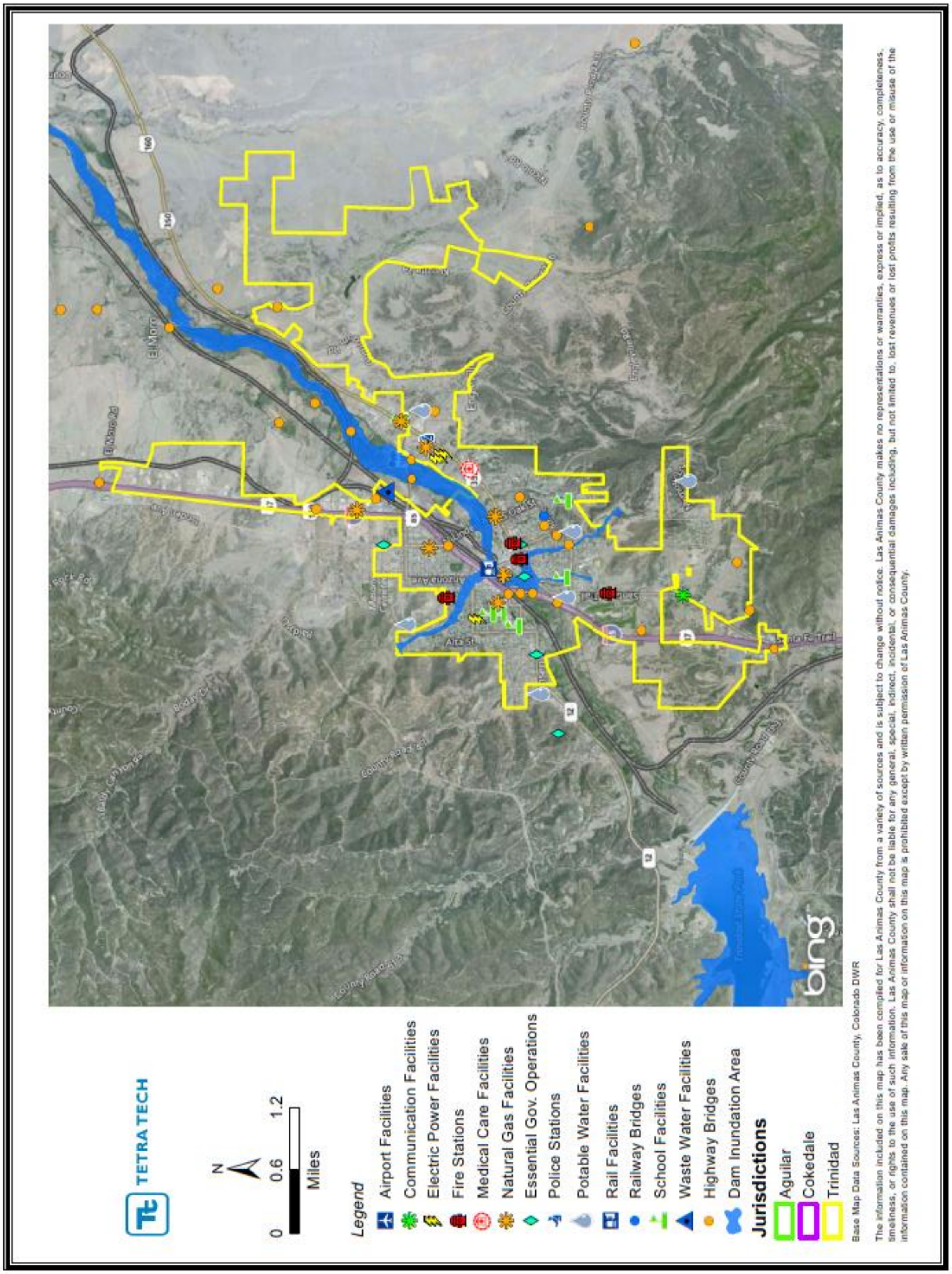


Figure 8-3. Critical Facilities and Infrastructure in Dam Inundation Areas in and near the City of Trinidad

8.2.3 Frequency and Severity

There have been no recorded occurrences of dam failures in or near Las Animas County in the past 80 years. Therefore the probability of a failure in the future is minimal for the county. The Steering Committee members for the county and City of Trinidad feel that the likelihood of occurrence over the next 100 years is moderate since there are high-hazard dams with inundation areas within their jurisdictions. The Steering Committee members for the Towns of Aguilar and Cokedale, and SFPD feel that the likelihood of future occurrence is low for their jurisdictions. There are no levees in the county.

The USACE developed the classification system shown in Table 8-2 for the hazard potential of dam failures. The USACE hazard rating system is based only on the potential consequences of a dam failure and does not take into account the probability of such failures.

TABLE 8-2.
U.S. ARMY CORPS OF ENGINEERS HAZARD POTENTIAL CLASSIFICATION

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers 1995

The Steering Committee members assessed the dam failure severity impact in three categories: impact on people, impact on property, and impact on the local economy. The severity of the dam failure hazard for the county and the City of Trinidad is considered to be medium as it could impact residents, residential, commercial, and industrial development, and disrupt essential facilities and infrastructure. The Towns of Aguilar and Cokedale, and SFPD believe the severity of dam failure to be low impact in their jurisdictions.

8.2.4 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam’s structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (USACE 1997).

8.3 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

8.4 CLIMATE CHANGE IMPACTS

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hydrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams have historically experienced increases in stream flows from earlier dam releases.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

8.5 EXPOSURE

Information for the exposure analysis provided in the sections below is based off of dam inundation area provided by Colorado Division of Water Resources. These areas are indicated in Figure 8-1 and Figure 8-2.

8.5.1 Population

An estimated population number impacted by dam failure was not available during this planning process. All but one of the high hazard dam emergency action plans were available and a description of the population at the greatest risk within the inundation area is described below.

- Apishapa Dam – the emergency action plan is obsolete and the population impacted is unknown. The emergency action plan is the responsibility of the dam owner.
- Fisher Peak Detention Dam FPC 1 – the number of homes and businesses within the inundation area is unknown. This dam is located in the City of Trinidad and the flood waters would travel north over open space to quickly join the Purgatoire River floodplain.
- Fisher Peak Detention Dam FPC 2 – the number of homes and businesses within the inundation area is unknown. This dam is located in the City of Trinidad and the flood waters would travel northeast over open space to join the Purgatoire River at 0.6 miles downstream of the dam.
- Monument Lake Dam – this dam is located in the rural, unincorporated county and the only know population would be at the Monument Park Campground just 0.1 miles downstream of the dam.
- North Lake Dam – the emergency action plan states that residential areas along the North Fork Purgatoire River and residential and commercial areas along the Purgatoire River will be impacted.
- Pinon Canyon Dam – the number of homes and businesses with the inundation area is unknown. This dam is located in the City of Trinidad and the flood waters would travel southeast between Willow Street and Pinon Street and would enter the Purgatoire River at 1.4 miles downstream of the dam.

- Trinidad Dam – there are10 houses, approximately 26 modular homes, and five businesses within the inundation area.

8.5.2 Property

An estimated value of property impacted by dam failure was not available during this planning process. If available from the emergency action plans, a description of the greatest risk property within the inundation area is described below.

- Apishapa Dam – the emergency action plan is obsolete and the property impacted is unknown.
- Fisher Peak Detention Dam FPC 1 – the number of homes and businesses within the inundation area is unknown.
- Fisher Peak Detention Dam FPC 2 – the number of homes and businesses within the inundation area is unknown.
- Monument Lake Dam – the only know property is Monument Park Campground just 0.1 miles downstream of the dam
- North Lake Dam – emergency action plan states that residential property along the North Fork Purgatoire River; residential and commercial areas along the Purgatoire River, including Weston, Primero High School and the Town of Segundo; roads and highways in and along Coal Creek, Guajatoyah Creek, North Fork Purgatoire River, and the Purgatoire River including County Road 21.6, Logging Canyon Road, and Highway 12 can be impacted.
- Pinon Canyon Dam – the number of homes and businesses with the inundation area is unknown.
- Trinidad Dam – two highways – Interstate 25 and Colorado 12 are within the inundation area.

8.5.3 Environment

Reservoirs held behind dams affect many ecological aspects of a river. River topography and dynamics depend on a wide range of flows, but rivers below dams often experience long periods of very stable flow conditions or saw-tooth flow patterns caused by releases followed by no releases. Water releases from dams usually contain very little suspended sediment; this can lead to scouring of river beds and banks.

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways, potentially causing the destruction of downstream habitats.

8.6 VULNERABILITY

Structures, aboveground infrastructure, critical facilities, and natural environments are all vulnerable to dam failure. With no known failures in the past, failure impacts would likely be limited in Las Animas County. Roads closed due to dam failure floods could result in serious transportation disruptions due to the limited number of roads in the county.

8.6.1 Population

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable timeframe. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system.

8.6.2 Property

Vulnerable properties are those within and close to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads, and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

8.6.3 Environment

The vulnerability of the environment to dam/levee failure is the same as the exposure, discussed in Section 9.5.3.

8.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. Dam failure is not typically addressed as a standalone hazard in the safety elements, but flooding is. The planning partners have established comprehensive policies regarding sound land use in identified flood hazard areas. Most of the areas vulnerable to the more severe impacts from dam failure are likely to intersect the mapped flood hazard areas. Flood-related policies in the general plans will help to reduce the risk associated with the dam failure hazard for all future development in the planning area.

8.8 SCENARIO

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam that impacts the planning area. While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs with historical record. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding.

8.9 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation areas. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.
- Mapping for federally regulated dams is already required and available; however, mapping for non-federal-regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federally regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and community

officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.

- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.

CHAPTER 9.
DROUGHT AND EXTREME HEAT

DROUGHT AND EXTREME HEAT HAZARD RANKING		
	Drought	**Extreme Heat**
Las Animas County	High	Medium
City of Trinidad	High	Medium
Town of Aguilar	Medium	Low
Town of Cokedale	High	High
Stonewall Fire Protection District	Low	Low
See Chapter 18 for more information on hazard ranking.		

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well-being, and quality of life.

Extreme Heat— Summertime weather that is substantially hotter or more humid than average for a location at that time of year.

9.1 GENERAL BACKGROUND

9.1.1 Drought

Drought is a normal phase in the climatic cycle of most geographical areas. According to the National Drought Mitigation Center, drought originates from a deficiency of precipitation over an extended period, usually a season or more. This results in a water shortage for some activity, group, or environmental sector. Drought is the result of a significant decrease in water supply relative to what is "normal" in a given location. Unlike most disasters, droughts normally occur slowly but last a long time. There are four generally accepted operational definitions of drought (National Drought Mitigation Center 2006):

Meteorological drought is an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific, and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.

Agricultural drought occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.

Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels. Water supply is controlled not only by precipitation, but also by other factors, including evaporation (which is increased by higher than normal heat and winds), transpiration (the use of water by plants), and human use.

Socioeconomic drought occurs when a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

Defining when drought begins is a function of the impacts of drought on water users, and includes consideration of the supplies available to local water users as well as the stored water they may have available in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions in their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors.

9.1.2 Extreme Heat

Excessive heat events are defined by the U.S. Environmental Protection Agency (EPA) as “summertime weather that is substantially hotter or more humid than average for a location at that time of year” (EPA 2006). Criteria that define an excessive heat event may differ among jurisdictions and in the same jurisdiction depending on the time of year. Excessive heat events are often a result of more than just ambient air temperature. Heat index tables (see Figure 9-1) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15 degrees Fahrenheit (°F). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution — Extreme Caution — Danger — Extreme Danger

Figure 9-1. Heat Index Table

9.2 HAZARD PROFILE

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Precipitation is the main source of Colorado's water supply. Annual precipitation in the populated areas of the planning area is approximately 11 to 15 inches per year. According to the *2013 Colorado State Drought Mitigation and Response Plan*, "there are no major rivers that flow into Colorado" (McKee et al. 1999). There are several major river basins originating in the Colorado Rockies, which flow out of the state, providing water to much of the southwestern United States, and contributing to the Missouri and Mississippi Rivers as well. Thus, Colorado earns its title as "the Mother of Rivers" (CWCB 2013). This supply is stored in five forms throughout the state: snowpack, streamflow, reservoir water, soil moisture, and groundwater (McKee and others 2000).

9.2.1 Past Events

Drought

According to the *2004 Drought and Water Supply Assessment*, Colorado has experienced multiple severe droughts. Colorado has experienced drought in 2011-2015, 2008-2008, 2002-2006, 1996, 1994, 1990, 1989, 1975-1979, 1963-1965, 1951-1957, 1931-1941, and 1893-1905. According to the *2013 Colorado Drought Mitigation and Response Plan*, several Secretarial Disasters occurred beginning in 2003. Table 9-1 lists these disasters.

TABLE 9-1.
USDA SECRETARIAL DISASTERS (2003-2015)

Year	Type	Declaration Number[a]
2003	Drought, Insects	S1843
2005	Drought	S2031
2005-2006	Drought, Crop Diseases, Insects	S2287
2005-2006	Drought, Fire, High Winds, Heat	S2327
2008	Drought	S2750
2009	Drought	S2996
2011	Drought	S3125, S3133, S3144
2012	Drought, Wind/High Winds, Heat/Excessive Heat	S3260
2012	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insects	S3282
2013	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insects	S3456, S3461, S3518
2014	Drought, High Winds, Wildfire, Heat, Insects	S3627, S3630
2015	Drought, High Winds, Wildfire, Heat, Insects	S3785, S3788

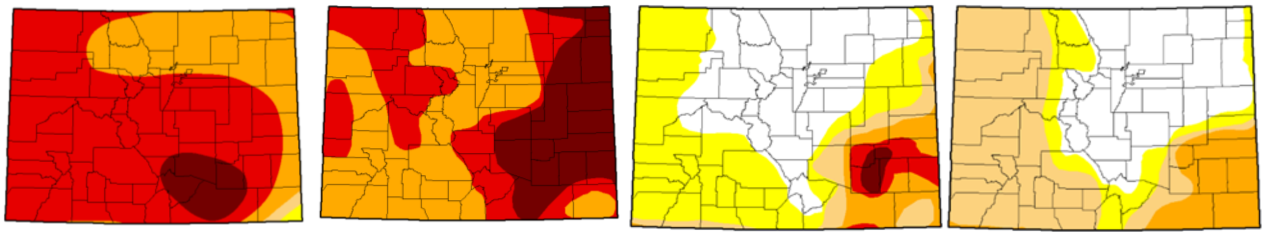
a. Secretarial Disaster Number

Source: U.S. Department of Agriculture, (http://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index)

Average annual precipitation for much of Las Animas County is 13 to 19 inches. Colorado has a history of periods of low precipitation and drought, including most recent years. The county experienced drought in the years of 2000, 2002, 2003, 2005-2006, 2008-2009 and 2011-2015 were active years for drought conditions. Conditions began improving in 2014, but the majority of the county was still experiencing severe drought conditions. Figure 9-2 compares the severity of the drought in Colorado in March 2003, with the severity of the drought in March 2013 as well as drought conditions as of March 2014 and March 2015.

The maps illustrate significantly improved conditions in Colorado and Las Animas County in 2015 over the 2003 conditions.

Source: National Drought Mitigation Center



3/18/2003 **3/19/2013** **3/18/2014** **3/17/2015**

State Drought Conditions

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
3/18/2003	0	100	99.75	98.82	69.97	7.27
3/19/2013	0	100	100	88.97	48.06	21.22
3/18/2014	38.90	61.10	21.62	13.69	5.58	1.47
3/17/2015	36.34	63.66	51.51	12.20	0	0

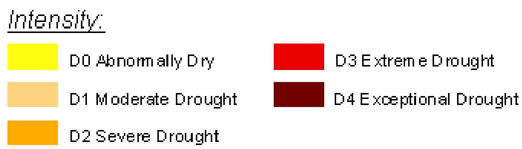


Figure 9-2. U.S. Drought Monitor for the State of Colorado from 2003, 2013, 2014, and 2015

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies. The database is being populated beginning with the most recent impacts and working backward in time. The Drought Impact Reporter contains information on 38 impacts from droughts that affected Las Animas County between 2006 and July 2016. The following are the categories and reported number of impacts. Note that some impacts have been assigned to more than one category.

Agriculture—21

Energy—0

Plants and Wildlife—11

Society and Public Health—4

Business and Industry—0

Fire—4

Tourism and Recreation—0

Relief, Response, and Restrictions—18

Water Supply and Quality—3

- **January – May 2014**—Fewer calves were born this year because of drought conditions.
- **August 2013 - May 2014**—The ongoing drought brought more and more tumbleweeds in southeastern Colorado, parts of New Mexico and the Texas panhandle.
- **June – August 2013**—The government allowed conservation reserve land to be hayed and grazed by farmers and ranchers because of the drought conditions. This led to the destruction of the nesting grounds of several birds that live in the CRP land. Pheasants and quail populations declined 70% during the drought.
- **June 2013**—Farmers had large agricultural fields that failed due to drought, dust on snow in the mountains causes the snow to melt faster which also means less water later in the season for irrigation.
- **July 2012**—Flow water from gas drilling provided water for livestock that ranchers west of Trinidad needed to sustain their herds through the dry summer of 2012. One rancher explained that wells were producing less water and that the water from coal bed methane was essential for many people.
- **April 2012**—A very warm, dry, and windy March led to a very high fire danger across much of south central and southeast Colorado. This prompted local officials to implement fire restrictions throughout the region.

According to the U.S. Department of Agriculture's (USDA) Risk Management Agency, payments for insured crop losses in Las Animas County as a result of drought conditions occurred between 2003 and 2015. Table 9-2 shows that $410,488 in payments were made for 5,130 acres that were affected during this time period. The highest claim years were 2013 and 2014.

TABLE 9-2.
CROP INSURANCE CLAIMS PAID FROM DROUGHT, 2003-2015

Crop Year	Commodity	Acres Affected	Indemnity Amount
2003	All crops	276	$6,354
2004	All crops	320	$1,707
2005	None	None	None
2006	All crops	586	$32,256
2007	None	None	None
2008	Wheat	160	$6,915
2009	Wheat	41	$1,735
2010	None	None	None
2011	All crops	887	$76,936
2012	Wheat	289	$26,720
2013	Wheat	1,229	$148,832
2014	Wheat	1,342	$109,033
2015	None	None	None
Total		**5,130**	**$410,488**

Source: USDA Risk Management Agency, http://www.rma.usda.gov/data/cause.html

Extreme Heat

The Western Regional Climate Center reports data summaries from a station in the City of Trinidad, the county seat in Las Animas County. Table 9-3 contains temperature summaries related to extreme heat for the station.

**TABLE 9-3.
TEMPERATURE DATA FROM TRINIDAD (1898-2012)**

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (degrees Fahrenheit)												
Average Maximum Temperature	48.5	51.1	56.9	64.9	73.5	83.1	86.8	84.7	79.1	69.3	56.8	49.0
Average Minimum Temperature	18.9	21.6	27.3	34.8	43.7	52.5	57.3	55.9	48.8	37.8	27.0	20.1
Average Temperature	33.7	36.3	42.1	49.9	58.6	67.8	72.1	70.3	63.9	53.6	41.9	34.5
Extreme Temperatures (degrees Fahrenheit)												
Extreme Maximum Temperature	78	83	88	89	96	101	101	99	99	90	87	82
Average Number of Days												
Maximum Temperature above 90 degrees Fahrenheit	0.0	0.0	0.0	0.0	0.3	6.2	10.3	6.0	1.3	0.0	0.0	0.0

According to the USDA's Risk Management Agency, payments for insured crop losses in Las Animas County as a result of heat and hot wind conditions occurred between 2003 and 2015. Table 9-4 shows that $198,734 in payments were made for 2,625 acres affected during this time period.

**TABLE 9-4.
CROP INSURANCE CLAIMS PAID FROM HEAT AND HOT WIND, 2003-2015**

Crop Year	Commodity	Acres Affected	Indemnity Amount
2003	None	None	None
2004	None	None	None
2005	None	None	None
2006	None	None	None
2007	None	None	None
2008	None	None	None
2009	Wheat	878	$61,412
2010	None	None	None
2011	All crops	680	$58,171
2012	Wheat	549	$29,112

TABLE 9-4.
CROP INSURANCE CLAIMS PAID FROM HEAT AND HOT WIND, 2003-2015

Crop Year	Commodity	Acres Affected	Indemnity Amount
2013	None	None	None
2014	Wheat	518	$50,039
2015	None	None	None
Total		**2,625**	**$198,734**

Source: USDA Risk Management Agency, http://www.rma.usda.gov/data/cause.html

9.2.2 Location

Drought

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.
- The ***Palmer Z Index*** measures short-term drought on a monthly scale.
- The ***Palmer Drought Index*** **(PDI)** measures the duration and intensity of long-term, drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and the PDI can respond fairly rapidly.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index*** **(PHDI)**, another long-term index, was developed to quantify hydrological effects. The PHDI responds more slowly to changing conditions than the PDI.
- While the Palmer indices consider precipitation, evapotranspiration and runoff, the ***Standardized Precipitation Index*** **(SPI)** considers only precipitation. In the SPI, an index of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The SPI is computed for time scales ranging from 1 to 24 months.

Due to Colorado's semiarid conditions, drought is a natural but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Colorado to be deficient in moisture at the same time. Single season droughts over some portion of the state are quite common.

The entire county is at risk to drought conditions. Drought is one of the few hazards that has the potential to directly or indirectly impact every person in the county as well as adversely affect the local economy.

Extreme Heat

The entire county is at risk to extreme heat events; however, these events may be exacerbated in urban areas, such as the City of Trinidad, where reduced air flow, reduced vegetation and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding rural or less urbanized areas. This phenomenon is known as urban heat island effect. Conversely, extreme heat events are unlikely to occur at higher elevations in Las Animas County. Average temperatures tend to decrease with increases in elevation, roughly 4°F per 1,000 feet above mean sea level.

9.2.3 Frequency and Severity

Drought

The probability of a future drought in Las Animas County is likely, with a recurrence interval of 10 years or less. According to information from the *2013 Colorado State Drought Mitigation and Response Plan*, over 119 years (1893 to 2012) there were 7 recorded drought incidents that totaled 41 dry years. Short duration droughts occur much more frequently. According to a study cited in the *2013 Colorado Drought Mitigation and Response Plan*, they occur somewhere in Colorado in nearly 9 out of every 10 years. (McKee and others 2000).

Drought impacts are wide-reaching and may be economic, environmental, or societal. The most significant impacts associated with drought in Colorado are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. An ongoing drought may leave an area more prone to beetle kill and associated wildfires. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wind and erosion. A reduction of electric power generation and water quality deterioration are also potential problems. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in streams and groundwater decline.

Due to the high probability of severe drought, the overall significance is considered to have a moderate potential impact. Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural—Drought threatens crops that rely on natural precipitation.
- Water supply—Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard—Drought increases the threat of wildfires from dry conditions in forest and rangelands.

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. These impacts are estimated to cost between $6 and $8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly.

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. A drought directly or indirectly impacts all people in affected areas. All people could pay more for water if utilities increase their rates due to shortages. Agricultural impacts can result in loss of work for farm workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

Drought also is often accompanied by extreme heat. When temperatures reach 90ºF and above, people are vulnerable to sunstroke, heat cramps, and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well.

Additionally, there is increased danger of wildfires associated with most droughts. Millions of board feet of timber have been lost, and in many cases erosion occurred, which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers.

Based on the information in this hazard profile, the magnitude/severity of drought is considered to have a high potential impact for the county, the City of Trinidad and the Town of Cokedale. The Steering Committee members from the Town of Aguilar considered drought to have a medium magnitude/severity and the SFPD Steering Committee members consider the magnitude/severity for drought to be a low potential impact.

Extreme Heat

There are no recorded instances of extreme heat or heat events in Las Animas County from 1950 to 2015 in the National Centers for Environmental Information Storm Events Database. However, there are approximately 24 days per year on average where temperatures exceed 90°F.

Based on the information in this hazard profile, the probability of an extreme heat event is medium. The Steering Committee representatives agreed with the assessment, except for the Town of Cokedale believes that their probability of occurrence is high and the Town of Aguilar and the SFPD believes their probability of occurrence to be low. The magnitude/severity of extreme heat is considered to have a medium potential impact for Las Animas County and the City of Trinidad, low for the Town of Aguilar and the SFPD, and a high impact for the Town of Cokedale.

9.2.4 Warning Time

Drought

Droughts are climatic patterns that occur over long periods of time. Only generalized warnings can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

Colorado is semiarid, thus, drought is a regular and natural occurrence in the state. The main source of water supply in the state is precipitation and much of this occurs in the winter as snowfall. Although drought conditions are difficult to predict, low levels of winter snowpack may act as an indicator that drought conditions are occurring.

Extreme Heat

NOAA issues watch, warning and advisory information for extreme heat. Meteorologists can often predict extreme heat days in advance.

9.3 SECONDARY HAZARDS

Drought

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. According to the *2013 Colorado State Drought Mitigation and Response Plan*, economic impacts may also occur for industries that are water intensive such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation and wildfire preservation. Additionally, a reduction of electric power generation and water quality deterioration are also potential effects. Drought conditions can also cause soil to compact, decreasing its ability to absorb water, making an area more susceptible to flash flooding and erosion. A drought may also increase the speed at which dead and fallen trees dry out and become more potent fuel sources for wildfires. Drought may also weaken trees in areas already affected by mountain pine beetle infestations, causing more extensive damage to trees and increasing wildfire risk, at least temporarily. An ongoing drought that severely inhibits natural plant growth cycles may impact critical wildlife habitats. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline (CWCB 2013).

Extreme Heat

Excessive heat events can cause failure of motorized systems such as ventilation systems used to control temperatures inside buildings.

9.4 CLIMATE CHANGE IMPACTS

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. From 1987 to 1989, losses from drought in the U.S. totaled $39 billion (Congressional Office of Technology Assessment [OTA] 1993). More frequent extreme events such as droughts could end up being more cause for concern than the long-term change in temperature and precipitation averages.

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

9.5 EXPOSURE

All people, property, and environments in the planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions. Populations living in densely populated urban areas are likely to be more exposed to extreme heat events. People who live at higher elevations would be less susceptible to heat events.

According to the USDA, the market value of crops grown in Las Animas County was $3.1 million in 2012, with another $25.2 million in livestock sales. Drought and extreme heat may impact all crops grown in Las Animas County and the pastureland used to sustain livestock.

Figure 5-3 and Figure 5-4 show exposure locations for annual average minimum temperatures and annual average maximum temperatures. In Las Animas County, the warmest temperatures are almost parallel to everything west of Interstate 25 in the county. This includes the City of Trinidad and the Towns of Aguilar and Cokedale which have similar average annual temperatures. The SFPD is located on the western portion of the county with lower average maximum temperatures.

Economic impacts will be largely associated with industries that use water or depend on water for their business. For example, landscaping businesses were affected in the droughts of the past as the demand for service significantly declined because landscaping was not watered. Agricultural industries will be impacted if water usage is restricted for irrigation.

9.6 VULNERABILITY

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. Extreme heat can exacerbate the effects of drought.

9.6.1 Population

Drought

The planning partnership has the ability to minimize any impacts on residents and water consumers in the county should several consecutive dry years occur. No significant life or health impacts are anticipated as a result of drought within the planning area.

Extreme Heat

According to the EPA, the individuals with the following combinations or characteristics are typically at greater risk to the adverse effects of excessive heat events: individuals with physical or mobility constraints, cognitive impairments, economic constraints, and social isolation.

9.6.2 Property

Drought

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Extreme Heat

Typically the only impact extreme heat has on general building stock is increased demand on air conditioning equipment, which in turn may cause strain on electrical systems.

9.6.3 Critical Facilities

Drought

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

Extreme Heat

Power outages may occur as a result of extreme heat events. Additionally, transportation systems may experience disruption in services. According to the *2013 Colorado Natural Hazards Mitigation Plan*, concrete pavements have experienced "blowouts or heaves" both on local highway and the higher volume parkway and interstate systems. Blowouts occur when pavements expand and cannot function properly within their allotted spaces. Pavement sections may rise up several inches during such events. These conditions can cause motor vehicle accidents in their initial stages and can shut down traffic lanes or roadways entirely until such times as the conditions are mitigated (Colorado Division of Emergency Management 2011).

9.6.4 Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

9.7 FUTURE TRENDS IN DEVELOPMENT

Each municipal planning partner in this effort has an established comprehensive plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation initiatives to increase the capability to deal with future trends in development. Vulnerability to drought will increase as population growth increases, putting more demands on existing water supplies. Future water use planning should consider increases in population as well as potential impacts of climate change.

9.8 SCENARIO

An extreme multiyear drought could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout the planning area, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water supplies relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of Las Animas County could experience setbacks, especially in water dependent industries.

9.9 ISSUES

The following are extreme heat and drought-related issues:

- Identification and development of alternative water supplies
- Utilization of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods
- Increasing vulnerability to drought over time as demand for water from different sectors increases
- The effects of climate change may result in an increase in frequency of extreme heat events
- The effects of recent droughts have exposed the vulnerability of the planning areas economy to drought events

CHAPTER 10. EARTHQUAKE

EARTHQUAKE HAZARD RANKING	
Las Animas County	Medium
City of Trinidad	High
Town of Aguilar	Low
Town of Cokedale	High
Stonewall Fire Protection District	Medium
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates.

Liquefaction—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

10.1 GENERAL BACKGROUND

10.1.1 How Earthquakes Happen

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

10.1.2 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as **magnitude**; or by the impact on people and structures, measured as **intensity**.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (M_W) scale, with the follow classifications of magnitude:

- Great—$M_W \geq 8$
- Major—$M_W = 7.0 - 7.9$
- Strong—$M_W = 6.0 - 6.9$
- Moderate—$M_W = 5.0 - 5.9$
- Light—$M_W = 4.0 - 4.9$
- Minor—$M_W = 3.0 - 3.9$
- Micro—$M_W < 3$

Estimates of M_W scale roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the M_W scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, M_W scale is now the most often used estimate of large earthquake magnitudes.

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (U.S. Geological Survey [USGS] 1989):

- I. Not felt except by a very few under especially favorable conditions.
- II. Felt only by a few persons at rest, especially on upper floors of buildings.
- III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
- IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
- V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
- VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
- VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
- VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
- XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
- XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

10.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g., single-family dwellings). Longer period response components create the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 10-1 lists damage potential and perceived shaking by PGA factors, compared to the modified Mercalli scale.

TABLE 10-1.
MERCALLI SCALE AND PEAK GROUND ACCELERATION COMPARISON

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X - XII	Extreme	Very Heavy	Very Heavy	>124%

PGA Peak Ground Acceleration

a. PGA measured in percent of g (%g), where g is the acceleration of gravity

Sources: USGS 2008; USGS 2010

10.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the earthquake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 10-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E, and F. In general, these areas are also most susceptible to liquefaction.

TABLE 10-2.
NEHRP SOIL CLASSIFICATION SYSTEM

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

Notes:
m Meters
m/s Meters per second
NEHRP National Earthquake Hazard Reduction Program

10.2 HAZARD PROFILE

Earthquakes can last from a few seconds to over 5 minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer, and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

10.2.1 Past Events

Colorado has a relatively short period of historical records for earthquakes. An earthquake and fault map developed by the Colorado Geological Survey depicts the location of historical epicenters and potentially active faults in that state. Figure 10-2 shows the faults and recorded earthquakes for Las Animas County and vicinity. The figure is a collection of all known and catalogued earthquakes in the area. Table 10-3 lists the 17 recorded earthquake events in Las Animas County.

TABLE 10-3.
EARTHQUAKE EVENTS IN LAS ANIMAS COUNTY

Name/Location	Magnitude/Intensity	Date
Northeast of Trinidad	4.5	1966
West of Trinidad (swarm of four reported)	4.2	1973
Northeast of Trinidad	3.2	1983
Northeast of Trinidad (a series of three reported)	3.2	1996
Town of Segundo	4.6	9/5/2001
37 miles from county center	4.4	3/22/2004
47 miles from county center	4.4	8/1/2004
31 miles from county center	5.0	8/10/2005
30 miles from county center	4.6	1/3/2007
Southwest of Trinidad	5.3	8/22/2011
West of Trinidad	4.2	8/20/2015
West Southwest of Trinidad	2.9	10/18/2015
West of Trinidad	3.2	12/29/2015
West Southwest of Trinidad	4.0	2/6/2016
West Southwest of Trinidad	2.8	3/13/2016
West of Trinidad	3.5	2/03/2016
West Southwest of Trinidad	3.9	8/23/2016

Source: Colorado Geological Survey (http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/trinidad-earthquakes/:)

- August 22, 2011—The earthquake occurred in a sparsely populated area about 15 miles southwest of Trinidad. This caused damage to 46 structures and two residents were condemned.

Figure 10-1. Photo of Earthquake Damage from the August 22, 2011 event.

Source: Colorado Geological Survey (http://dnrwebmapgdev.state.co.us/cgsonline/)

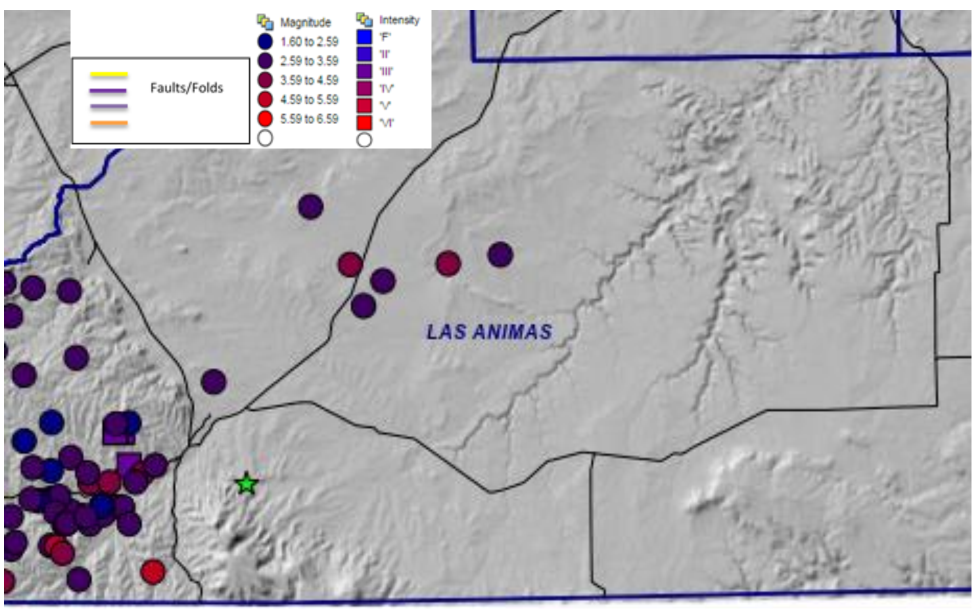


Figure 10-2. Earthquake Faults and Recorded Epicenters Map for Las Animas County and Vicinity

10.2.2 Location

Geological research indicates that faults capable of producing earthquakes are prevalent in Colorado. There are approximately 90 potentially active faults in Colorado with documented movement within the last 1.6 million years. Las Animas County does not contain major faults, but the Sangre de Cristo Fault runs north/south (at the base of the Sangre de Cristo Mountains along the eastern edge of the San Luis Valley) just west of Las Animas County and the smaller, Cheraw Fault, lies north in Las Animas County and runs thru Kiowa, Otero, and Crowley Counties. Figure 10-2 and Figure 10-3 show potentially active faults in or near Las Animas County and in all of Colorado, respectively. More than 700 earthquake tremors of a magnitude 2.5 or higher have been recorded in Colorado since 1867. This is considered relatively infrequent for a western state.

Source: Colorado Earthquake Hazard Mitigation Council 2008

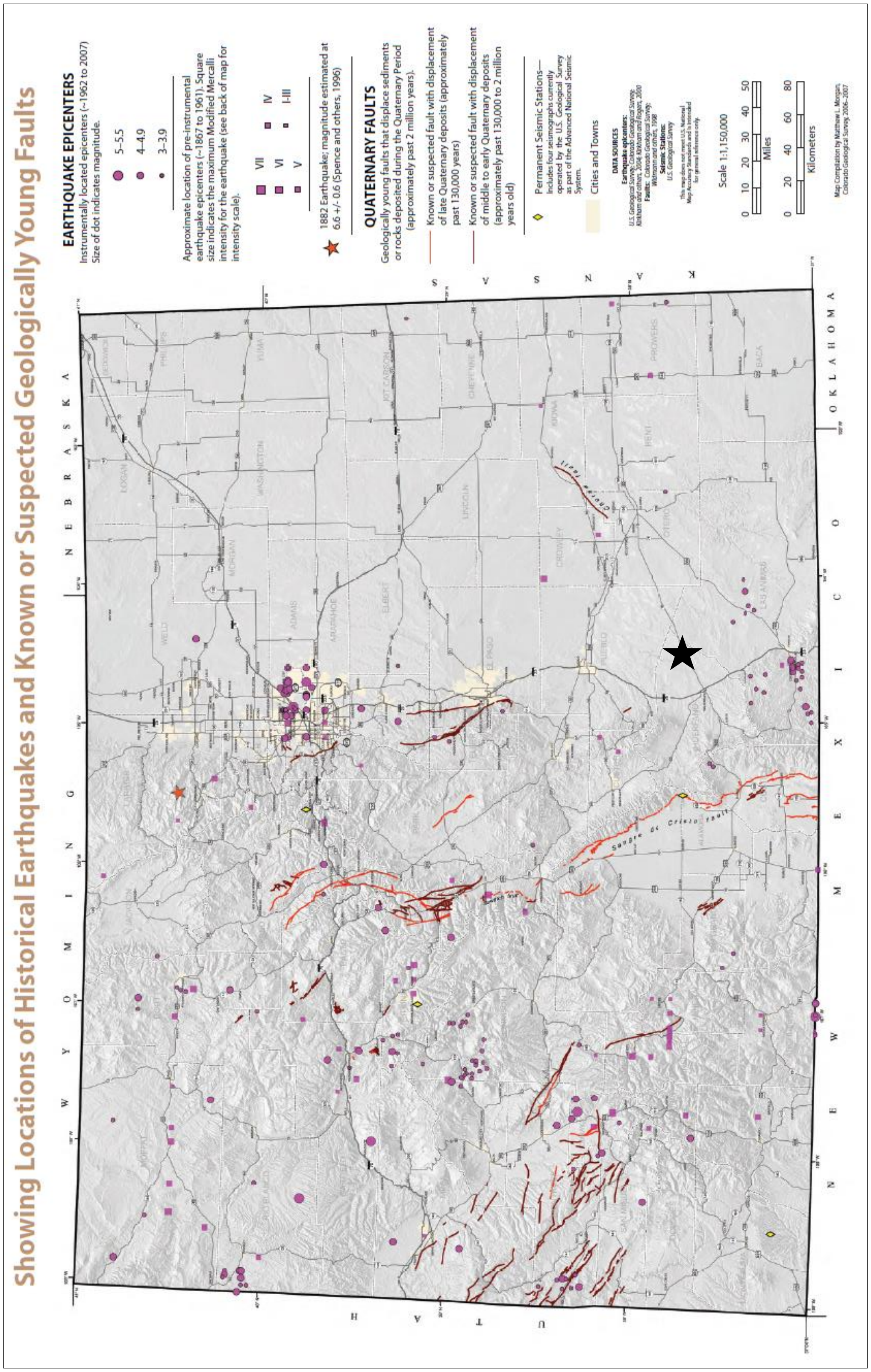


Figure 10-3. Colorado Earthquakes and Fault Map

Faults have been classified based on the geologic time frame of their latest suspected movement (in order of activity occurrence, most recent is listed first):

- H—Holocene (within past 15,000 years)
- LQ—Late Quaternary (15,000 to 130,000 years)
- MLQ—Middle to Late Quaternary (130,000 to 750,000 years)
- Q—Quaternary (approximately past 2 million years)
- LC—Late Cenozoic (approximately past 23.7 million years)

The Sawatch Fault and the Sangre de Cristo Fault (indicated on Figure 10-3) were used in earthquake scenarios for Las Animas County.

10.2.3 Frequency and Severity

Research based on Colorado's earthquake history suggests that an earthquake with a magnitude 6.3 or larger has a 1% probability of occurring each year somewhere in Colorado (Charlie, Doehring, Oaks Colorado Earthquake Hazard Reduction Program Open File Report 93-01 1993).

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Damage and life loss can be particularly devastating in communities where buildings were not designed to withstand seismic forces (e.g., historic structures). Other damage-causing effects of earthquakes include surface rupture, fissuring, settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, rock falls, liquefaction, fires, dam failure, and hazardous materials (HAZMAT) incidents.

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking on people, buildings, and natural features. According to FEMA's *2006 Homebuilder's Guide to Earthquake Resistant Design and Construction*, the International Residential Code designates the level of potential seismic hazard for dwellings by assigning a house to a Seismic Design Category based on its location. Las Animas County is in Category B (17% to 33% of the force of gravity) and has the potential of moderate ground shaking.

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is calculated based on the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally measured value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

Mapping that shows the impacts of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. One probabilistic scenario and one earthquake scenario were selected for this plan:

500-Year Probabilistic Scenario (see Figure 10-4)—This is a HAZUS-MH Probabilistic Event scenario, which allows the user to generate estimates of damage and loss based on the seismic hazard for a specified return period.

Cheraw Fault Scenario (see Figure 10-5)—A magnitude 7.0 event with an epicenter at La Junta (80 miles north east of Trinidad). This is a HAZUS-MH Arbitrary-Event scenario, which is defined by the location of its epicenter and by its magnitude. The epicenter is defined by latitude and longitude. The following user-specified parameter was used:

- Magnitude – 7.0

North Sangre de Cristo Fault Scenario (see Figure 10-6)—A magnitude 7.5 event with an epicenter being in the Sangre de Cristo Mountains approximately 50 miles north east of Las Animas County. This is a HAZUS-MH Arbitrary-Event scenario, which is defined by the location of its epicenter and by its magnitude. The epicenter is defined by latitude and longitude. The following user-specified parameter was used:

- Magnitude – 7.5

According to the information in this hazard profile, a large earthquake's impact on the county would be moderate. Due to the high probability of damaging earthquakes, the overall significance is considered to have a moderate potential impact for Las Animas County and SFPD and a high impact for the City of Trinidad and the Town of Cokedale. The City of Aguilar believes the earthquake hazard to be a low impact.

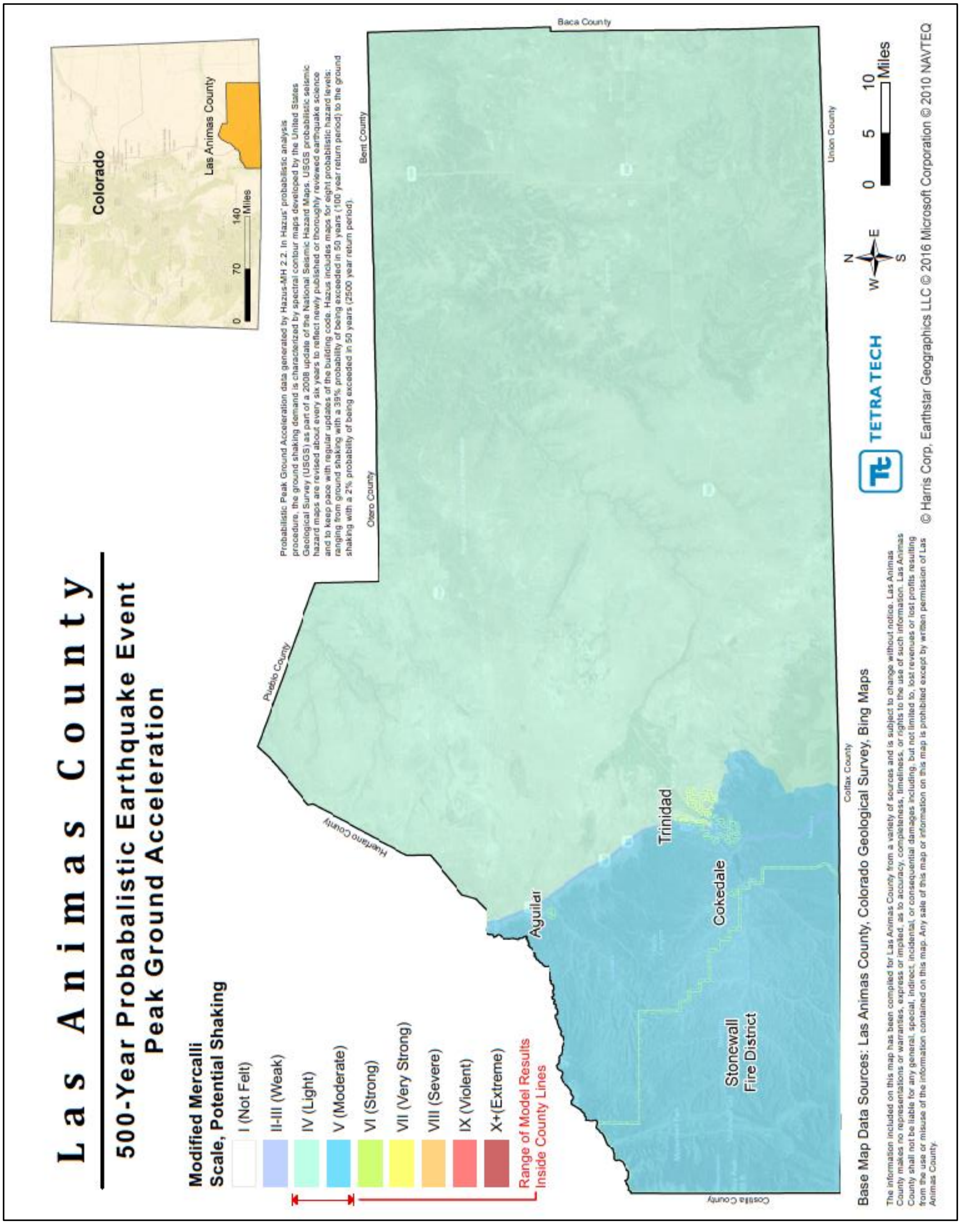


Figure 10-4. 500-Year Probabilistic Event

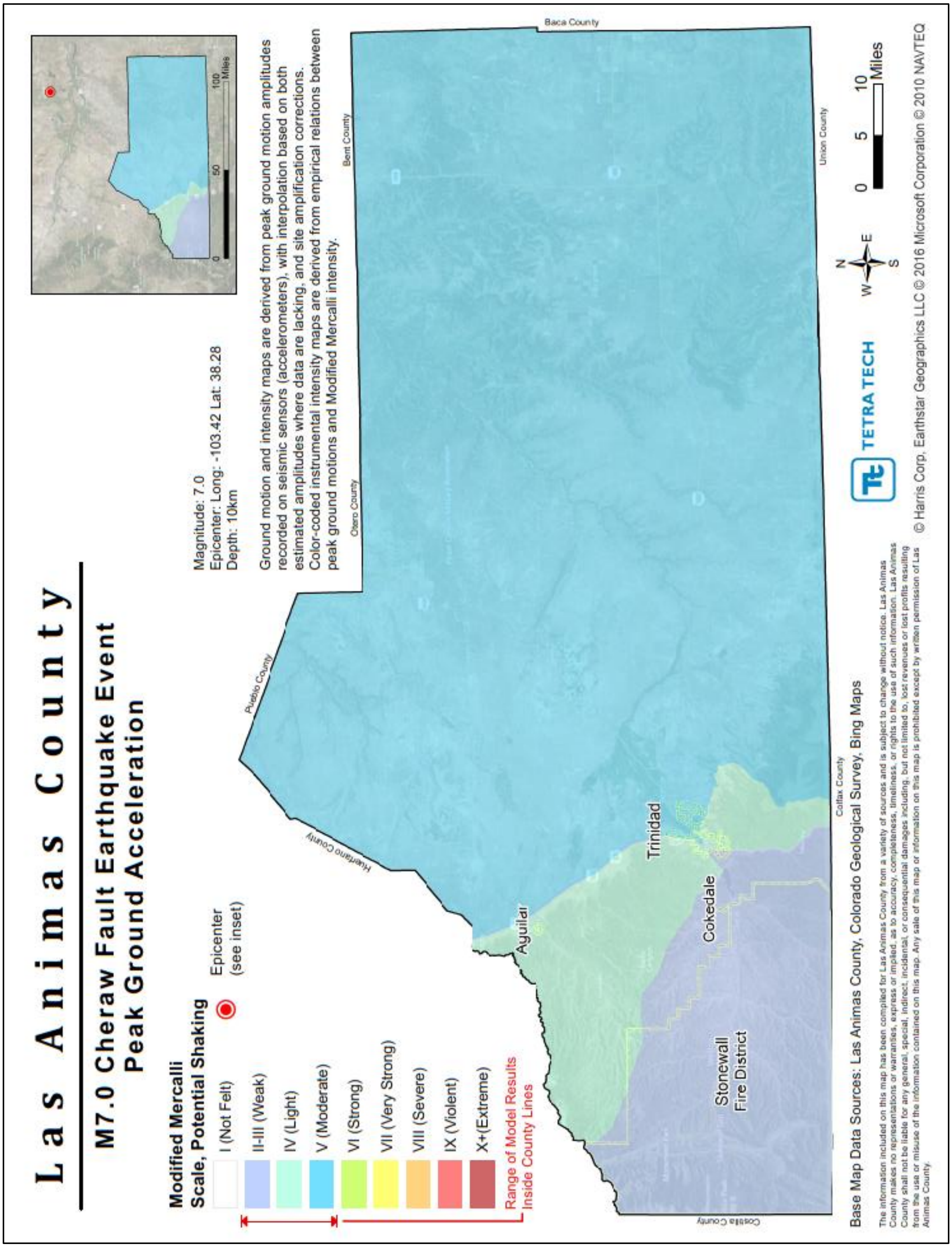


Figure 10-5. Cheraw Fault Magnitude 7.0 Event

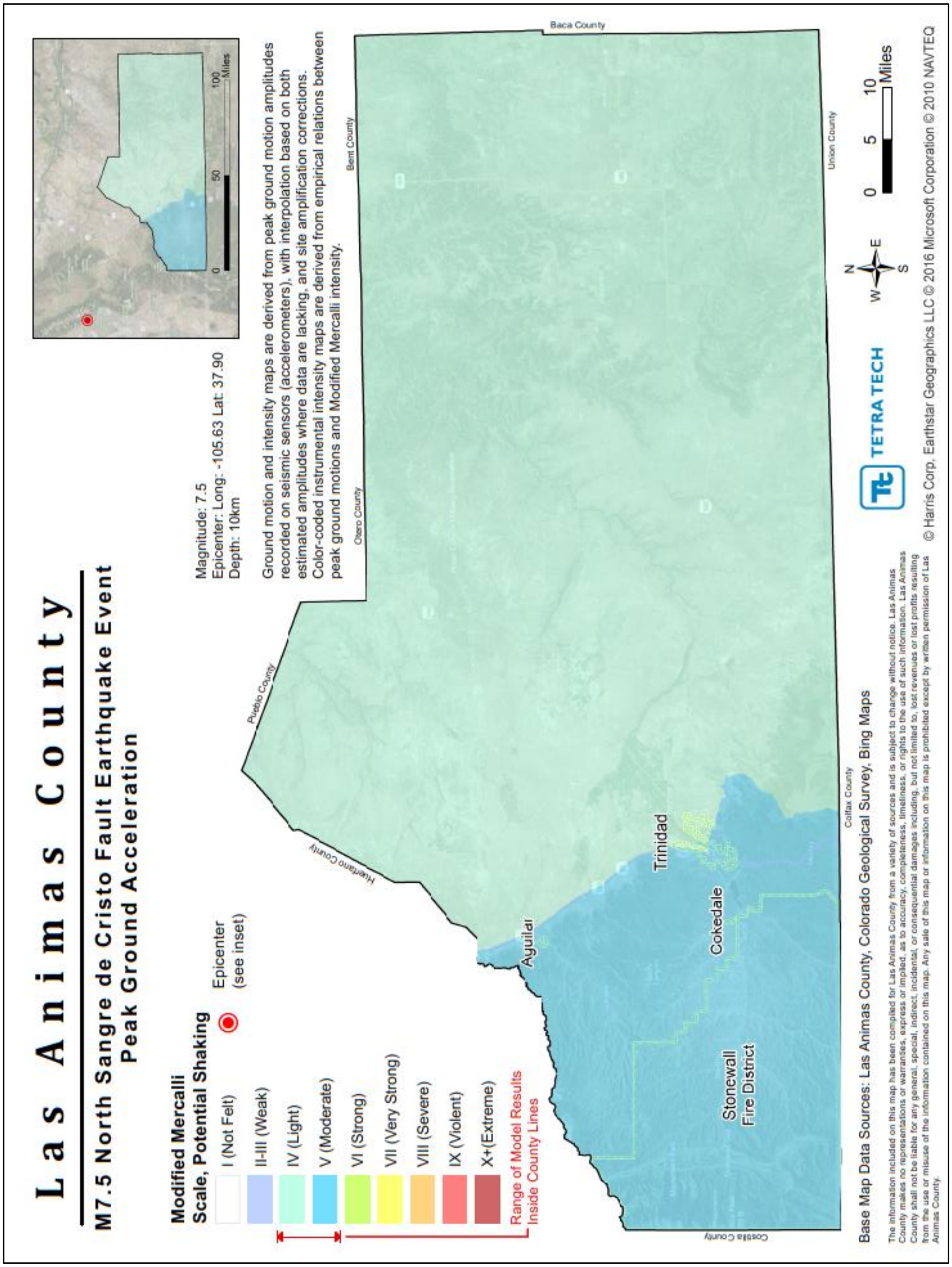


Figure 10-6. Sangre de Cristo Fault Magnitude 7.5 Event

10.2.4 Warning Time

Part of what makes earthquakes so destructive is that they generally occur without warning. The main shock of an earthquake can usually be measured in seconds, and rarely lasts for more than a minute. Aftershocks can occur within the days, weeks, and even months following a major earthquake.

By studying the geologic characteristics of faults, geoscientists can often estimate when the fault last moved and estimate the magnitude of the earthquake that produced the last movement. Because the occurrence of earthquakes is relatively infrequent in Colorado and the historical earthquake record is short, accurate estimations of magnitude, timing, or location of future dangerous earthquakes in Colorado are difficult to estimate.

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

10.3 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts, or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

10.4 CLIMATE CHANGE IMPACTS

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth’s crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. The National Aeronautics and Space Administration (NASA) and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

10.5 EXPOSURE

10.5.1 Population

The entire population of Las Animas County is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. Whether impacted directly or indirectly, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

10.5.2 Property

According to Las Animas County Tax Assessor data, there are 14,232 buildings in the planning area, with a total assessed value of $331 million. Because all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the countywide property exposure to seismic events.

10.5.3 Critical Facilities and Infrastructure

All critical facilities and infrastructure in the planning area are exposed to the earthquake hazard. Table 5-4 and Table 5-5 list the number of each type of facility by jurisdiction. HAZMAT releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding HAZMAT are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

10.5.4 Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. Streams can be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

10.6 VULNERABILITY

Earthquake vulnerability data was generated using a Level 2 HAZUS-MH analysis. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

10.6.1 Population

Three population groups are particularly vulnerable to earthquake hazards:

- **Linguistically Isolated Populations**—Approximately 3.6% of the planning area population over 5 years old speaks English “less than very well.” Problems arise when there is an urgent need to inform non-English speaking residents of an earthquake event. They are vulnerable because of difficulties in understanding hazard-related information from predominantly English-speaking media and government agencies.
- **Population Below Poverty Level**—Families with incomes below the poverty level in 2014 made up 20.1% of all families in Las Animas County. These families may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Poorer residents are also less likely to have insurance to compensate for losses in earthquakes.
- **Population Over 65 Years Old**—Approximately 19.9% of the residents in Las Animas County are over 65 years old. This population group is vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

Impacts on persons and households in the planning area were estimated for the 500-Year Probabilistic Earthquake, the Cheraw Fault scenario and the North Sangre de Cristo Fault scenario events through the Level 2 HAZUS-MH analysis. Table 10-4 summarizes the results.

**TABLE 10-4.
ESTIMATED EARTHQUAKE IMPACT ON PERSONS AND HOUSEHOLDS**

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
500-Year Earthquake	1	0
Cheraw Fault Scenario	0	0
North Sangre de Cristo Fault Scenario	2	1

10.6.2 Property

Building Age

Table 10-5 identifies significant milestones in building and seismic code requirements that directly affect the structural integrity of development. Using these time periods, the planning team used HAZUS-MH based on the 2010 U.S. Census data to identify the number of structures in the planning area by date of construction. The number of structures does not reflect the number of total housing units, as many multi-family units and attached housing units are reported as one structure. Approximately 42% of the structures were built before 1940 when there were no building permits, inspections, or seismic standards.

**TABLE 10-5.
AGE OF STRUCTURES IN LAS ANIMAS COUNTY**

Time Period	Number of Current Planning Area Structures Built in Period	Significance of Time Frame
Pre-1940	3,443	Before 1933, there were no explicit earthquake requirements in building codes. State law did not require local governments to have building officials or issue building permits.
1941-1959	970	In 1960, the Structural Engineers Association of California published guidelines on recommended earthquake provisions.
1960-1979	1,215	In 1975, significant improvements were made to lateral force requirements.
1980-1998	1,906	In 1994, the Uniform Building Code was amended to include provisions for seismic safety.
1999-Present	690	Seismic code is currently enforced.
Total	**8,224**	

Loss Potential

Property losses were estimated through the Level 2 HAZUS-MH analysis for the 500-Year Probabilistic Earthquake the Cheraw Fault scenario and the North Sangre de Cristo Fault scenarios. Table 10-6, Table 10-7, and Table 10-8 show the results for two types of property loss:

- Structural loss, representing damage to building structures.
- Non-structural loss, representing the value of lost contents.

The total of the two types of losses is also shown in the tables. A summary of the property-related loss results is as follows:

- For a 500-Year Probabilistic Earthquake, the estimated damage potential is $2,055,095, or 0.07% of the total replacement value for the planning area.
- For a 7.0-magnitude Cheraw Fault scenario, the estimated damage potential is $636,821, or 0.02% of the total replacement value for the planning area.
- For a 7.5-magnitude North Sangre de Cristo scenario, the estimated damage potential is $5,280,589, or 0.19% of the total replacement value for the planning area.

TABLE 10-6.
LOSS ESTIMATES FOR 500-YEAR PROBABILISTIC EARTHQUAKE

	Estimated Loss Associated with Earthquake		
	Structure	Contents	**Total**
Aguilar	$49,309	$9,456	**$58,765**
Cokedale	$32,085	$7,207	**$39,292**
Stonewall FPD	$368,668	$82,798	**$451,466**
Trinidad	$844,745	$171,700	**$1,016,444**
Rest of County	$409,686	$79,443	**$489,129**
Las Animas County Total	**$1,704,492**	**$350,603**	**$2,055,095**

TABLE 10-7.
LOSS ESTIMATES FOR CHERAW FAULT SCENARIO EARTHQUAKE

	Estimated Loss Associated with Earthquake		
	Structure	Contents	**Total**
Aguilar	$0	$0	**$0**
Cokedale	$0	$0	**$0**
Stonewall FPD	$0	$0	**$0**
Trinidad	$126,097	$22,262	**$148,358**
Rest of County	$415,167	$73,295	**$488,462**
Las Animas County Total	**$541,264**	**$95,557**	**$636,821**

TABLE 10-8.
LOSS ESTIMATES FOR NORTH SANGRE DE CRISTO FAULT SCENARIO EARTHQUAKE

	Estimated Loss Associated with Earthquake		
	Structure	Contents	**Total**
Aguilar	$164,647	$35,691	**$200,338**
Cokedale	$95,171	$22,420	**$117,592**
Stonewall FPD	$1,093,700	$257,630	**$1,351,330**
Trinidad	$1,875,444	$397,212	**$2,272,656**
Rest of County	$1,101,044	$237,629	**$1,338,673**
Las Animas County Total	**$4,330,006**	**$950,583**	**$5,280,589**

The HAZUS-MH analysis also estimated the amount of earthquake-caused debris in the planning area for the 500-Year Probabilistic Earthquake, the Cheraw Fault scenario and the North Sangre de Cristo Fault scenario events, as summarized in Table 10-9.

TABLE 10-9.
ESTIMATED EARTHQUAKE-CAUSED DEBRIS

	Debris to Be Removed (tons)
500-Year Earthquake	1.12
Cheraw Fault Scenario	0.35
North Sangre de Cristo Fault Scenario	2.65

10.6.3 Critical Facilities and Infrastructure

Level of Damage

HAZUS-MH classifies the vulnerability of critical facilities to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each critical facility in the planning area except HAZMAT facilities and "other infrastructure" facilities, for which there are no established damage functions. The analysis was performed all scenario events. Table 10-10, Table 10-11, and Table 10-12 summarize the results.

TABLE 10-10.
ESTIMATED DAMAGE TO CRITICAL FACILITIES AND INFRASTRUCTURE FROM 500-YEAR EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health	95.57%	4.15%	0.27%	0.00%	0.00%
Protective Functions	97.64%	2.12%	0.21%	0.01%	0.00%
Schools	98.21%	1.61%	0.15%	0.01%	0.00%
Government Functions	96.38%	2.41%	1.03%	0.16%	0.00%
Potable Water	90.18%	9.02%	0.76%	0.02%	0.00%
Wastewater	90.72%	8.51%	0.72%	0.02%	0.00%
Communication	93.45%	6.14%	0.37%	0.01%	0.00%

Electric	93.38%	6.21%	0.38%	0.01%	0.00%
Natural Gas	92.01%	7.43%	0.52%	0.02%	0.00%
Transportation Systems	99.71%	0.27%	0.02%	0.01%	0.00%
Total	**94.73%**	**4.79%**	**0.44%**	**0.03%**	**0.00%**

TABLE 10-11.
ESTIMATED DAMAGE TO CRITICAL FACILITIES AND INFRASTRUCTURE FROM CHERAW FAULT SCENARIO EVENT

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health	99.06%	0.90%	0.03%	0.00%	0.00%
Protective Functions	99.57%	0.38%	0.04%	0.00%	0.00%
Schools	99.37%	0.56%	0.05%	0.00%	0.00%
Government Functions	98.59%	0.87%	0.44%	0.07%	0.00%
Potable Water	99.96%	0.04%	0.00%	0.00%	0.00%
Wastewater	99.77%	0.21%	0.01%	0.00%	0.00%
Communication	99.94%	0.05%	0.00%	0.00%	0.00%
Electric	99.92%	0.07%	0.00%	0.00%	0.00%
Natural Gas	99.94%	0.05%	0.00%	0.00%	0.00%
Transportation Systems	99.71%	0.16%	0.06%	0.05%	0.02%
Total	**99.58%**	**0.33%**	**0.06%**	**0.01%**	**0.00%**

TABLE 10-12.
ESTIMATED DAMAGE TO CRITICAL FACILITIES AND INFRASTRUCTURE FROM NORTH SANGRE DE CRISTO FAULT SCENARIO EVENT

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health	92.53%	6.84%	0.60%	0.01%	0.00%
Protective Functions	94.28%	4.93%	0.72%	0.04%	0.00%
Schools	96.33%	3.23%	0.40%	0.02%	0.00%
Government Functions	93.08%	4.43%	2.11%	0.35%	0.00%
Potable Water	80.71%	16.31%	2.78%	0.16%	0.01%
Wastewater	82.10%	14.96%	2.73%	0.17%	0.01%
Communication	91.12%	8.24%	0.60%	0.02%	0.00%
Electric	91.14%	8.23%	0.59%	0.02%	0.00%
Natural Gas	87.26%	11.51%	1.16%	0.04%	0.00%
Transportation Systems	98.31%	1.11%	0.33%	0.19%	0.03%
Total	**90.69%**	**7.98%**	**1.20%**	**0.10%**	**0.01%**

Time to Return to Functionality

HAZUS-MH estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, HAZUS-MH may estimate that a facility has 5% chance of being fully functional at Day 3, and a 95% chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for all scenario events. Table 10-13 and Table 10-14 summarize the results.

TABLE 10-13.
FUNCTIONALITY OF CRITICAL FACILITIES FOR 500-YEAR EVENT

Planning Unit	Number of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health	1	95.5%	95.6%	99.6%	99.7%	99.9%	99.9%
Protective Functions	18	97.6%	7.6%	99.6%	99.7%	99.9%	99.9%
Schools	18	98.1%	98.1%	99.7%	99.7%	99.9%	99.9%
Government Functions	11	96.3%	96.4%	98.7%	98.7%	99.7%	99.9%
Potable Water	11	95.2%	99.6%	99.9%	99.9%	99.9%	99.9%
Wastewater	3	93.4%	98.9%	99.8%	99.9%	99.9%	99.9%
Communication	1	99.7%	99.9%	99.9%	99.9%	99.9%	99.9%
Electric	3	99.7%	99.7%	99.9%	99.9%	99.9%	99.9%
Natural Gas	11	96.7%	99.6%	99.8%	99.9%	99.9%	99.9%
Transportation Systems	221	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Total/Average	**298**	**97.2%**	**89.5%**	**99.7%**	**99.7%**	**99.9%**	**99.9%**

TABLE 10-14.
FUNCTIONALITY OF CRITICAL FACILITIES FOR CHERAW SCENARIO EVENT

Planning Unit	Number of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health	1	99%	99%	99.9%	99.9%	99.9%	99.9%
Protective Functions	18	99.5%	99.5%	99.8%	99.8%	99.9%	99.9%
Schools	18	99.3%	99.3%	99.8%	99.8%	99.9%	99.9%
Government Functions	11	98.5%	98.5%	99.4%	99.4%	99.8%	99.9%
Potable Water	11	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Wastewater	3	99.8%	99.9%	99.9%	99.9%	99.9%	99.9%
Communication	1	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Electric	3	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Natural Gas	11	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Transportation Systems	221	99.8%	99.8%	99.9%	99.9%	99.9%	99.9%
Total/Average	**298**	**99.6%**	**99.6%**	**99.8%**	**99.8%**	**99.9%**	**99.9%**

**TABLE 10-15.
FUNCTIONALITY OF CRITICAL FACILITIES FOR NORTH SANGRE DE CRISTO EVENT**

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%) at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health	1	92.5%	92.6%	99.2%	99.3%	99.9%	99.9%
Protective Functions	18	94.2%	94.3%	99.0%	99.1%	99.8%	99.8%
Schools	18	96.2%	96.3%	99.4%	99.5%	99.9%	99.9%
Government Functions	11	93.0%	93.2%	97.4%	97.4%	99.5%	99.9%
Potable Water	11	90.6%	99.1%	99.7%	99.7%	99.8%	99.9%
Wastewater	3	87.0%	97.1%	99.5%	99.7%	99.7%	99.9%
Communication	1	99.6%	99.9%	99.9%	99.9%	99.9%	99.9%
Electric	3	96.6%	99.6%	99.8%	99.9%	99.9%	99.9%
Natural Gas	11	94.7%	99.2%	99.8%	99.9%	99.9%	99.9%
Transportation Systems	221	99.2%	99.5%	99.6%	99.7%	99.7%	99.8%
Total/Average	**298**	**94.4%**	**97.1%**	**99.3%**	**99.4%**	**99.8%**	**99.8%**

10.6.4 Environment

The environment vulnerable to earthquake hazard is the same as the environment exposed to the hazard.

10.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by the comprehensive plans adopted by the county and its planning partners as well as local permitting departments and zoning maps. The information in this plan provides the participating partners a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The International Building Code also establishes provisions to address seismic risk.

10.8 SCENARIO

An earthquake does not have to occur within the planning area to have a significant impact on the people, property and economy of the county. Any seismic activity of magnitude 6.0 or greater on faults within or near the planning area would have significant impacts throughout the county. Earthquakes of this magnitude or higher would lead to massive structural failure of property on highly liquefiable soils. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils.

10.9 ISSUES

Important issues associated with an earthquake include but are not limited to the following:

- Critical facility owners should be encouraged to create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.

- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the county.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Failures could happen at multiple locations, increasing the impacts of the individual events.
- The cost of retro-fitting buildings to meet earthquake seismicity standards may be cost-prohibitive.
- Dams located in the county may not have been engineered to withstand probable seismic events.
- Information regarding liquefaction susceptibility of soils in the planning area is lacking.

CHAPTER 11.
EROSION AND DEPOSITION, EXPANSIVE SOIL, AND SUBSIDENCE

EROSION AND DEPOSITION, EXPANSIVE SOIL, AND SUBSIDENCE HAZARD RANKING			
	Erosion and Deposition	**Expansive Soil**	**Subsidence**
Las Animas County	Low	Low	Low
City of Trinidad	Medium	Low	Medium
Town of Aguilar	Low	Low	Low
Town of Cokedale	Low	Medium	High
Stonewall Fire Protection District	Low	Low	Low
See Chapter 18 for more information on hazard ranking.			

11.1 GENERAL BACKGROUND

11.1.1 Erosion and Deposition

The Colorado Geological Survey defines erosion as “the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice” (Colorado Geological Survey 2014). Deposition is defined as “the placing of eroded material in a new location” (Colorado Geological Survey 2014). According to the Colorado Geological Survey, all material that is eroded is later deposited in another location. Both erosion and deposition are continually occurring phenomenon, although the rate of erosion and deposition varies tremendously and can be affected by a variety of factors including rate of scour, type of material being eroded, and the presence or absence of vegetation.

DEFINITIONS

Ground Subsidence—Ground subsidence is the sinking of land over human-caused or natural underground voids and the settlement of native low density soils.

Soil Erosion—Soil erosion is the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice.

Deposition—Deposition is the placing of eroded material in a new location.

11.1.2 Expansive Soil

Expansive and collapsible soils are some of the most widely distributed and costly geologic hazards. Collapsible soils are a group of soils that can rapidly settle or collapse the ground. They are also known as metastable soils and are unsaturated soils that undergo changes in volume and settlement in response to wetting and drying, often resulting in severe damage to structures. The sudden and usually large volume change could cause considerable structural damage.

Expansive soil and rock are characterized by clayey material that shrinks as it dries or swells as it becomes wet. In addition, trees and shrubs placed closely to a structure can lead to soil drying and subsequent shrinkage. The parent (source) rock most associated with expansive soils is shale. Figure 11-1 shows expansive soil distribution in United States.

Collapsible soils consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading. Soil collapse occurs when the land surface is saturated at depths greater than those reached by typical rain events. This saturation eliminates the clay bonds holding the soil grains together. Similar to expansive soils, collapsible soils result in structural damage such as cracking of the foundation, floors, and walls in response to settlement.

11.1.3 Subsidence and Sinkholes

According to the *2013 Colorado Natural Hazards Mitigation Plan*, "ground subsidence is the sinking of land over human caused or natural underground voids and the settlement of native low density soils" (Colorado Division of Emergency Management 2015). Subsidence can occur gradually over time or virtually instantaneously. There are many different types of subsidence; however, in Colorado, there are three types of subsidence that warrant the most concern: settlement related to collapsing soils, sinkholes in karst areas, and the ground subsidence over abandoned mine workings.

Collapsible Soils

Collapsible soils are a group of soils that can rapidly settle or collapse the ground. The most common type of collapsible soil is hydrocompactive soil. According to the Colorado Geological Survey, "hydrocompactive soils form in semi-arid to arid climates in the western U.S. and large parts of Colorado in specific depositional environments" (Colorado Geological Survey 2014). These soils are low in density and in moisture content and are loosely packed together. Agents that bind these loosely packed particles together, such as clay and silk buttresses, are water sensitive. When water is introduced to these soils, the binding agents may quickly break down, soften, disperse, or dissolve. This results in a reorganization of the soil particles in a more dense arrangement, which in turn results in a net volume loss indicated by resettlement or subsidence at the surface (Colorado Geological Survey 2014). Volume loss can be anywhere in between 10% to 15%, which can result in several feet of surface-level displacement.

Sinkholes in Karst Areas

Most sinkholes in Colorado are related to the dissolution of evaporite minerals or limestone. Evaporite minerals dissolve in water and include gypsum and halite. Rocks containing limestone also form sinkholes based on dissolution by water. The term "karst" describes a landscape that has been shaped by the dissolution of these types of bedrock (Colorado Geological Survey 2014). According to a newsletter issued by the Colorado Geological Survey, "two characteristics of evaporative bedrock are important. One is that evaporative minerals can flow, like a hot plastic, when certain pressures and temperatures are exceeded. The second, and most important to land use and development is that evaporative minerals dissolve in the presence of freshwater. It is this dissolution of the rock that creates caverns, open fissures, streams out letting from bedrock, breccia pipes, subsidence sags and depressions, and sinkholes" (Colorado Geological Survey 2001).

Factors leading to the formation of sinkholes in these landscapes may be natural or may be induced by human activities. Natural contributing factors include the downward percolation of surface water through the rock formation or the lateral movement of water within a water table. Human activities that may contribute to such subsistence include stream channel changes, irrigation ditches, land irrigation leaking or broken pipes, temporary or permanent ponding of surface waters, and mining of soluble materials by means of forced circulation of water (Colorado Geological Survey 2014).

Abandoned Mine Workings

The underground removal of minerals and rock can undermine underground support systems and lead to void spaces. These voids can then be affected by natural and man-made processes such as caving, changes in flowage, or changes in overlying rock and soil material resulting in collapse or subsidence. Hazards from these abandoned sites are complicated by the fact that many "final mine maps" are inaccurate or incomplete (Colorado Geological Survey 2014). Mines operating after August 1997 were required by federal and state law to take potential surface subsidence into account; however, mining has been an activity in the state since the 1860s (Colorado Geological Survey 2001). There are some mapped, known mine hazard areas in Colorado and in Las Animas County; however, it is likely that there are additional hazard areas for which no records exist.

11.2 HAZARD PROFILE

11.2.1 Past Events

Erosion and Deposition

Soil erosion and deposition are ongoing events that can be affected by both natural and human-induced processes. Soil erosion and deposition events are continually occurring throughout the county. Portions of the county vary between highly erodible land to areas of not highly erodible land. The majority of the highly erodible land is in higher sloped and mountainous areas.

Expansive Soil

Las Animas County soils are mostly underlain by soils with less than 50% clay. The higher elevation areas along the western border have soils with over 50% clay. Expanding soils can cause structural damage; however, past events are difficult to identify and measure.

Source: USGS. http://ngmdb.usgs.gov/Prodesc/proddesc_10014.htm

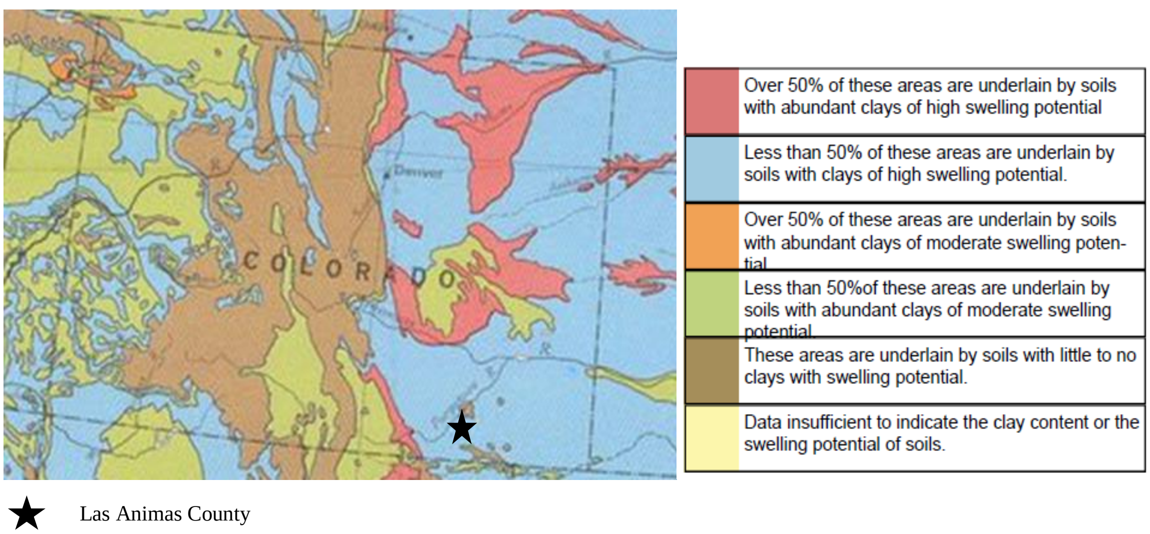


Figure 11-1. Expansive Soils in the State of Colorado

Subsidence and Sinkholes

The occurrence of subsidence is an on-going process resulting from natural and human-induced causes. There are no historic sinkholes in Las Animas County and according to the USGS and the risk of ground collapse is low.

11.2.2 Location

Erosion and Deposition

Soil erosion and deposition occur in all parts of the county. Point sources of erosion often occur in areas where humans interact with exposed areas of the earth's surface, such as construction sites. Waterways are continually involved in erosion and deposition processes. Erosion and deposition may be exacerbated in areas where wildfires have occurred. According to the *2013 State of Colorado's Hazard Mitigation Plan*, "there is a high risk for erosion in the aftermath of a wildfire event. As a fire burns, it destroys plant material and the layers of litter that blanket the floor of an ecosystem. These materials, as well as trees, grasses, and shrubs, buffer and stabilize the soil from intense rainstorms. The plant materials slow runoff to give rainwater time to percolate into the ground. When fire destroys this protective later, rain and wind wash over the unprotected soil and erosion occurs" (Colorado Division of Emergency Management 2015). Areas in Las Animas County that were recently burned are more susceptible to exacerbated erosion and deposition. Additionally, areas with high slopes and mountainous regions have a higher susceptibility to soil erosion.

Figure 11-3 shows the average erosion potential in tons per acre per year from water (streams/rivers/creeks and precipitation) in Las Animas County. Las Animas County, the City of Trinidad, and the SFPD Steering Committee members feel they have a moderate potential for erosion because of water flow from creeks and rivers. The Towns of Aguilar and Cokedale Steering Committee members feel that they have low erosion potential.

Expansive Soil

Colorado is home to expansive soil, particularly bentonite. The leading cause of foundation damage in this type of soil is uneven moisture. Drying soil can shift and crack foundation as it shrinks. When moisture is applied, the resulting swelling can crumble foundation. The planning area is exposed to minimal risks from expansive soil since this county has very little underlay of clay soils.

Subsidence and Sinkholes

According to the Colorado Geological Survey, "Most catalogued sinkholes of Colorado lie on surficial deposits such as flat-lying glacial outwash terraces, recent valley side sediments, or older deposits on pediment slopes overlying the evaporite bedrock. The highest density of sinkholes that are manifested at the surface in Colorado occur in the Garfield County, Eagle County, Rio Blanco County, and Park County" (Colorado Geological Survey 2001).

In the northeast corner of Las Animas County, there are areas of gypsum mining and along the Interstate-25 corridor from north to south and locations west of Trinidad have undermined coal areas. Figure 11-2 shows the evaporative bedrock, historic gypsum mining, and undermined coal areas for Las Animas County. Figure 11-3 shows the average erosion potential in tons per acre per year for the county based on slope, water drainage, and other factors.

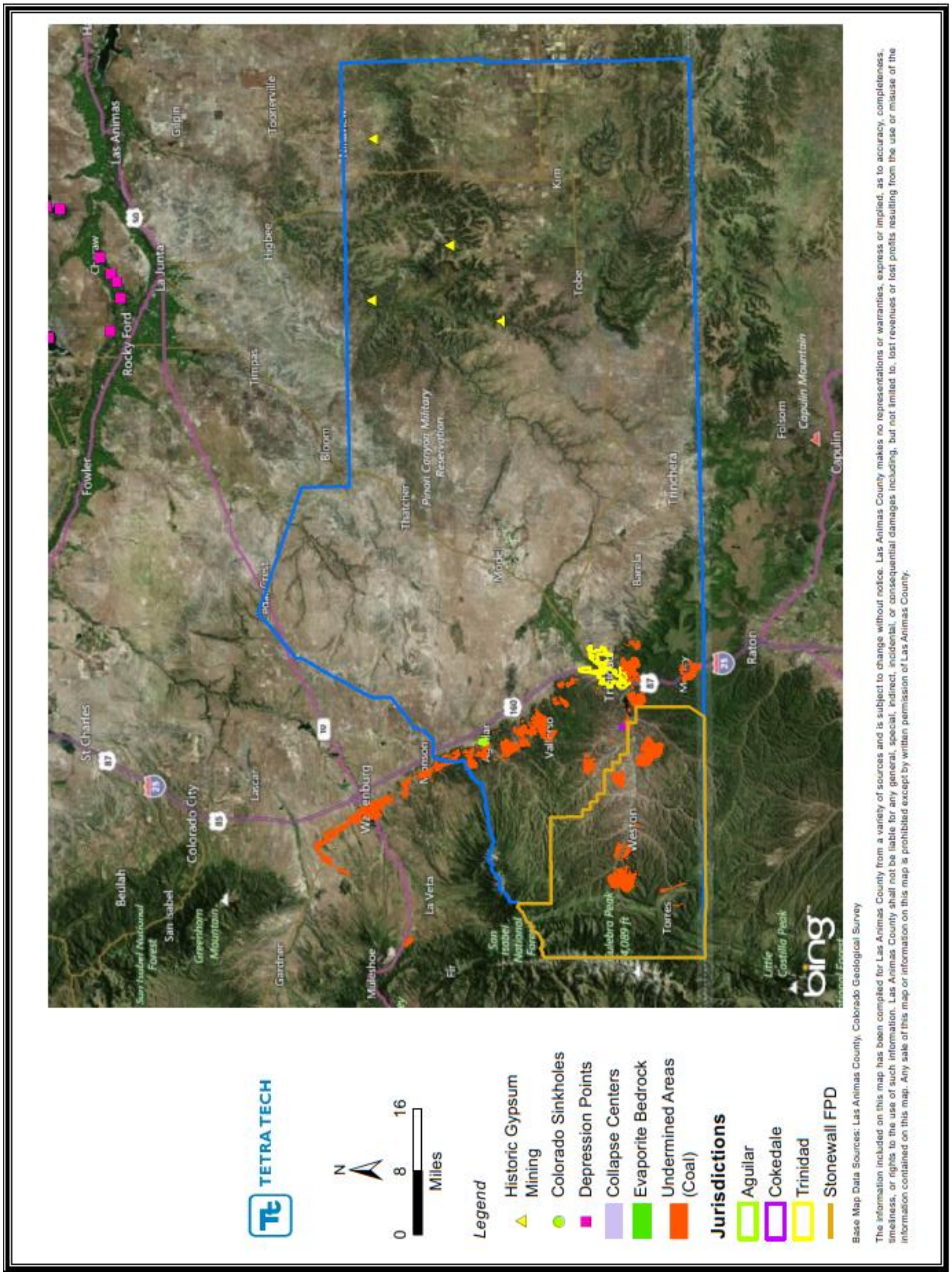


Figure 11-2. Evaporative Bedrock, Historic Gypsum Mining, and Undermined Coal Areas

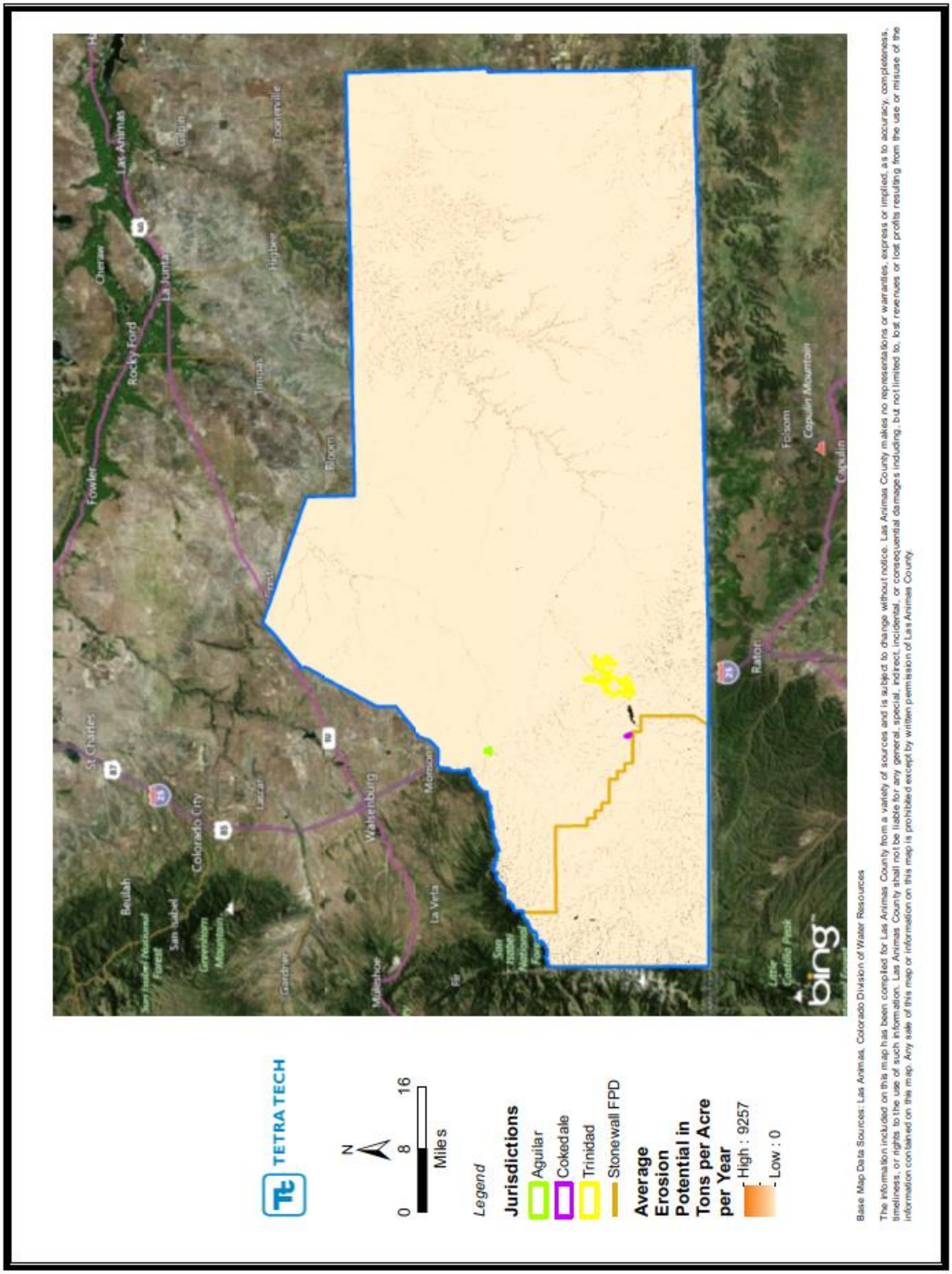


Figure 11-3. Average Erosion Potential in Tons per Acre per Year

11.2.3 Frequency and Severity

Erosion and deposition, subsidence, and sinkholes are occurring continuously throughout the county. Large precipitation events as well as human activity may influence the frequency of these events.

The severity of erosion, deposition, subsidence, and sinkholes is largely related to the extent and location of areas that are impacted. Such events can cause property damage as well as loss of life; however, events may also occur in remote areas of the county where there is little to no impact to people or property. According to the Colorado Geological Survey, “In general, the type and severity of surface subsidence is governed by the amount of ground surface and the location of removal or compression, and the geological conditions of a particular site” (Colorado Geological Survey 2014).

Based on the information in this hazard profile, the magnitude/severity of erosion and deposition, expansive soil, and subsidence is considered to have a low potential impact for the county. The City of Trinidad Steering Committee members believe the city has moderate potential impact for erosion and deposition and subsidence, but low exposure to expansive soil. The Town of Aguilar’s Steering Committee members believe the town has low exposure to erosion and deposition, expansive soil, and subsidence. The Town of Cokedale’s Steering Committee members believe the town has low potential impacts from erosion and deposition along with moderate impacts from expansive soils and subsidence hazards. The SFPD’s Steering Committee members believe they have low potential impact for erosion and deposition, expansive soil, and subsidence.

11.2.4 Warning Time

Subsidence can happen suddenly and without warning or can occur gradually over time. Soil erosion and deposition generally occurs gradually over time; however, these processes may be intensified as a result of natural or human-induced activities. According to Colorado Geological Survey, there are some instances where the rate of subsidence can be calculated, particularly subsidence that occurs as a result of mining activities (Colorado Geological Survey 2001):

> *Where longwall mining is active and subsidence is a well-documented and predictable action, surface response to ongoing mining can be accurately estimated. However, in the case of room and pillar mines, especially where they are inaccessible and record-keeping may be inaccurate, predictions of when subsidence will happen are not possible.*
>
> *How much subsidence will occur and the features that will appear at the surface depend not only on the type of mining but on geology and several physical features of the voids left by mining. Some general rules of thumb are:*
>
> - *The larger the mine opening height and width, the larger the subsidence feature at the surface.*
> - *The shallower the mine below ground, the more noticeable the surface subsidence evidence; however, in Colorado pits have been found over mines as deep as 350 feet.*
> - *The strength of the rock above the coal seam influences whether subsidence will reach the surface and the kind of features that can appear.*

11.3 SECONDARY HAZARDS

Events that cause damage to improved areas can result in secondary hazards, such as explosions from natural gas lines, loss of utilities such as water and sewer due to shifting infrastructure, and potential failures of reservoir dams. Additionally, these events may occur simultaneously with other natural hazards such as flooding. Erosion can cause undercutting that can result in an increase in landslide or rockfall hazards. Erosion can also cause a loss of topsoil, which can affect agricultural production in the area. Deposition can have impacts that aggravate flooding, bury crops, or reduce capacities of water reservoirs.

11.4 CLIMATE CHANGE IMPACTS

Changes in precipitation events and the hydrological cycle may result in changes in the rate of subsidence and soil erosion. According to a 2003 paper published by the Soil and Water Conservation Society (Soil and Water Conservation 2003):

> *The potential for climate change – as expressed in changed precipitation regimes – to increase the risk of soil erosion, surface runoff, and related environmental consequences is clear. The actual damage that would result from such a change is unclear. Regional, seasonal, and temporal variability in precipitation is large both in simulated climate regimes and in the existing climate record. Different landscapes vary greatly in their vulnerability to soil erosion and runoff. Timing of agricultural production practices creates even greater vulnerabilities to soil erosion and runoff during certain seasons. The effect of a particular storm event depends on the moisture content of the soil before the storm starts. These interactions between precipitation, landscape, and management mean the actual outcomes of any particular change in precipitation regime will be complex.*

11.5 EXPOSURE

11.5.1 Population

Residents of the county living or travelling in areas prone to subsidence and erosion are exposed to the hazard. Population exposure estimates are unavailable. The majority of the population is not exposed to subsidence. The mountainous regions have a higher risk of erosion.

11.5.2 Property

Structures and other improvements located in areas prone to subsistence or soil erosion are exposed to risk from these hazards, particularly structures located along streams and other waterways. Additionally, deposition may result in damage to structures and property.

11.5.3 Critical Facilities and Infrastructure

Any critical facilities or infrastructure that is located on or near areas prone to subsidence or soil erosion are exposed to risk from the hazard; particularly facilities located along streams and other waterways. Deposition may result in additional exposure to facilities and infrastructure, including dams, bridges, and roads.

11.5.4 Environment

Subsidence, erosion, and deposition are all naturally occurring processes, but can still cause damage to the natural environment. Environments located in areas prone to subsidence and deposition are exposed. Additionally, areas where sediments are deposited are also exposed.

11.6 VULNERABILITY

11.6.1 Population

The risk of injury or fatalities as a result of these hazards are limited, but possible. Spontaneous collapse and opening of voids are rare, but still may occur resulting in death or injury to any people in the area at the time. It is likely that any such injuries would be highly localized to the area directly impacted by an event. Erosion can adversely impact populations who have respiratory issues by reducing air quality, so those with existing respiratory issues are likely to be more vulnerable.

11.6.2 Property

Property exposed to subsidence and erosion can sustain minor damages or can result in complete destruction. According to the Colorado Geological Survey, merely an inch of differential subsidence beneath a residential structure can cause several thousand dollars of damage. Structures may be condemned as a result of this damage resulting in large losses. FEMA estimates that there are over $125 million in losses in the U.S. annually as a result of subsidence. Structures exposed to erosion hazard areas may be undermined, resulting in damages. This may also result in the condemnation of a structure. Additionally, physical loss land area may occur as a result of erosion.

11.6.3 Critical Facilities and Infrastructure

Subsidence can result in serious structural damage to critical facilities and infrastructure such as, roads, irrigation ditches, underground utilities and pipelines. According to the Colorado Geological Survey, large ground displacements caused by collapsing soils can totally destroy roads and structures and alter surface drainage. Minor cracking and distress may result as the improvements respond to small adjustments in the ground beneath them. Erosion can also impact structures such as bridges and roads by undermining their foundations. Structures and underground utilities found in areas prone to subsidence or soil erosion can suffer from distress. The shifting and settling of the structure can be seen in a number of ways:

- Settlement, cracking and tilting of concrete slabs and foundations,
- Displacement and cracking in door jams, window frames, and interior walls, or
- Offset cracking and separation in rigid walls such as brick, cinderblock, and mortared rock (Colorado Geological Survey 2001).

11.6.4 Environment

Ecosystems that are exposed to increased sedimentation as a result of erosion and deposition degrades habitat. However, some erosion and disposition is required for healthful ecosystem functioning. Ecosystems that are already exposed to other pressures, such as encroaching development, may be more vulnerable to impacts from these hazards.

11.7 FUTURE TRENDS IN DEVELOPMENT

According to the *2013 Colorado Natural Hazards Mitigation Plan* (Colorado Division of Homeland Security and Emergency Management [DHSEM] 2015):

> *Future development will continue to intersect subsidence hazard areas based on past and projected population growth. Important identification and mitigation strategies are necessary in engineering geology and geotechnical investigations within the evaporite terrain mapped. Avoidance is generally the best mitigation solution where subsidence features are exposed at the surface and properly identified. Many older sinkholes may be hidden. Only subsurface inspections, either by investigative trenching, a series of investigative borings, geophysical means, and/or observations made during overlot grading or utility installation, can ascertain whether sinkholes exist within a development area. Ground-modification and structural solutions can help mitigate the threat of localized subsidence. Drainage issues and proper water management are also important. In Colorado's semi-arid climate, additional increases of fresh water may accelerate dissolution and further destabilize certain subsidence areas.*

Jurisdictions in the planning area should ensure that known hazard areas are regulated under their planning and zoning programs. In areas where hazards may be present, permitting processes should require geotechnical investigations to access risk and vulnerability to hazard areas. Erosion issues generally do not impact land use except along river channels. Issues pertaining to land use in these areas are likely addressed through jurisdictional floodplain ordinances and regulations.

11.8 SCENARIO

A worst case scenario would occur if a rapidly occurring sinkhole opened up beneath a structure where many individuals lived or worked. This situation could result in a number of injuries or fatalities and would cause extensive damage to the area directly impacted.

11.9 ISSUES

The major issues for subsidence, expansive soils, erosion, and deposition are the following:

- Onset of actual or observed subsidence in many cases is related to changes in land use. Land uses permitted in known hazard areas should be carefully evaluated.
- Knowledge of hydrologic factors is critical for evaluating most types of ground subsidence.
- Abandoned mine information is incomplete. There are likely to be hazardous areas in addition to known locations.
- Some housing developments have had subsidence hazard investigations completed before development. This practice should be expanded.
- Homeowners within an undermined area that were built before 1989 are eligible to participate in the Mine Subsidence Protection Program, a federal program operated by the Mined Land Reclamation Board of the Division of Minerals and Geology. Homes built after 1989 are not covered.
- Many older sinkholes have been covered with recent soil infilling and are completely concealed at the surface.
- Human activities greatly influence the rate and extent of erosion and deposition. Activities should be evaluated before proceeding with them.
- Riverine erosion can reduce water quality and impact aquatic habitat as well as impacting private property and critical infrastructure.
- More detailed analysis should be conducted for critical facilities and infrastructure exposed to hazard areas. This analysis should address how potential structural issues were addressed in facility design and construction.

CHAPTER 12.
FLOOD

FLOOD HAZARD RANKING	
Las Animas County	Medium
City of Trinidad	High
Town of Aguilar	Low
Town of Cokedale	Low
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1% chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1% annual chance flood is the standard used by most federal and state agencies.

Riparian Zone—The area along the banks of a natural watercourse.

12.1 GENERAL BACKGROUND

12.1.1 Flood

The following section is excerpted from the *2013 Colorado State Hazard Mitigation Plan.*

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from:

- The overflow of stream banks
- The unusual and rapid accumulation of runoff of surface waters from any source
- Mudflows or the sudden collapse of shoreline land

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat sloped) streams.

The causes of floods relate directly to the accumulation of water from precipitation, rapid snowmelt, or the failure of man-made structures, such as dams or levees. Floods caused by precipitation are further classified as coming from: rain in a general storm system, rain in a localized intense thunderstorm, melting snow, rain on melting snow, and ice jams. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure‘s capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised due to age, poor construction and maintenance, seismic activity, rodent tunneling, or myriad other causes. For more information on floods resulting from dam and levee failure refer to Chapter 9 of this plan.

General Rain Floods

General rain floods can result from moderate to heavy rainfall occurring over a wide geographic area lasting several days. They are characterized by a slow steady rise in stream stage and a peak flood of long duration. As various minor streams empty into larger and larger channels, the peak discharge on the mainstream channel may progress upstream or downstream (or remain stationary) over a considerable length of river.

General rain floods can result in considerably large volumes of water. The general rain flood season is historically from the beginning of May through October. Because the rate of rise is slow and the time available for warning is great, few lives are usually lost, but millions of dollars in valuable public and private property are at risk.

Thunderstorm Floods

Damaging thunderstorm floods are caused by intense rain over basins of relatively small area. They are characterized by a sudden rise in stream level, short duration, and a relatively small volume of runoff. Because there is little or no warning time, the term “flash flood” is often used to describe thunderstorm floods. The average number of thunderstorm days per year in Colorado varies from less than 40 near the western boundary to over 70 in the mountains along the Front Range. The thunderstorm flood season in Colorado is from the middle of July through October.

Snowmelt Floods

Snowmelt floods result from melting of winter snowpack in the high mountain areas. Snowmelt floods typically begin as spring runoff appears, after the first spring warming trend. If the warming trend continues up to 8 to 10 consecutive days in a basin where the snowpack has a water content more than about 150% of average, serious flooding can develop. The total duration of snowmelt floods is usually over a period of weeks rather than days. They yield a larger total volume in comparison to other types of floods in Colorado. Peak flows, however, are generally not as high as flows for the other types. A single cold day or cold front can interrupt a melting cycle causing the rising water to decline and stabilize until the cycle can begin again. Once snowmelt floods have peaked, the daily decreases are moderate, but fairly constant. Snowmelt flooding usually occurs in May, June, and early July.

Rain on Snowmelt Floods

Rain on snow flooding occurs most often in Colorado during the month of May. Generally, at this time of year large rainstorms occur over western Colorado. These rainstorms are most often caused when warm moist air from the Gulf of Mexico begins pushing far enough north that it begins to affect western weather. In combination with this movement of air mass is the continued possibility of cold fronts moving into Colorado from the Pacific Northwest. When these weather phenomena collide, long-lasting general rainstorms can often occur. Rain on snowmelt exacerbates an already tenuous situation as snowmelt waters rush down heavily incised stream channels. Any abnormal increase in flow from other sources usually causes streams to leave their banks.

During the summer months of May and June when rivers are running high, there is a potential for flooding due to rain falling on melting snow. Usually such rain is over a small part of a basin, and the resulting flood is of short duration and may often go unnoticed in the lower reaches of a large drainage basin. To some extent, the cloud cover associated with the rain system can slow the melting cycle and offset the compound effect. In some cases, however, rainfall may be heavy and widespread enough to noticeably affect peak flows throughout the basin.

Ice Jam Floods

Ice jam floods can occur by two phenomena. In the mountain floodplains during extended cold periods of 20 to 40 degrees below zero, the streams ice over. The channels are frozen solid and overbank flow occurs, which results in ice inundation in the floodplains. Ice jam floods can occur when frozen water in the upper reaches of a stream abruptly begins to melt due to warm Chinook winds. Blocks of ice floating downstream can become lodged at constrictions and form a jam. The jam can force water to be diverted from the stream channel causing a flood. An ice jam can also break up, suddenly causing a surge of water as the “reservoir” that was formed behind it is suddenly released. Ice jamming occurs in slow moving streams where prolonged periods of cold weather are experienced. Sometimes the ice jams are dynamited, allowing a controlled release of the backed up water to flow downstream.

12.1.2 Floodplain

A floodplain is the area adjacent to a river, creek, or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

12.1.3 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

12.1.4 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

12.1.5 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains.

It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

12.1.6 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1% annual chance flood and the 0.2% annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRM), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Las Animas County and the City of Trinidad participate in the regular NFIP program. The Town of Aguilar participates in the emergency NFIP program. The Town of Cokedale does not participate in the NFIP program. Structures permitted or built in the county before then are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." The insurance rate is different for the two types of structures. The effective date for the current countywide FIRM is April 3, 1984. The county and the City of Trinidad are currently in good standing with the provisions of the NFIP. Compliance is monitored by FEMA regional staff. Maintaining compliance under the NFIP is an important component of flood risk reduction.

The Community Rating System

The Community Rating System (CRS) is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses
- Facilitate accurate insurance rating
- Promote awareness of flood insurance

For participating communities, flood insurance premium rates are discounted in increments of 5%. For example, a Class 1 community would receive a 45% premium discount, and a Class 9 community would receive a 5% discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness

Figure 12-1 shows the nationwide number of CRS communities by class as of May 2012, when there were 1,211 communities receiving flood insurance premium discounts under the CRS program.

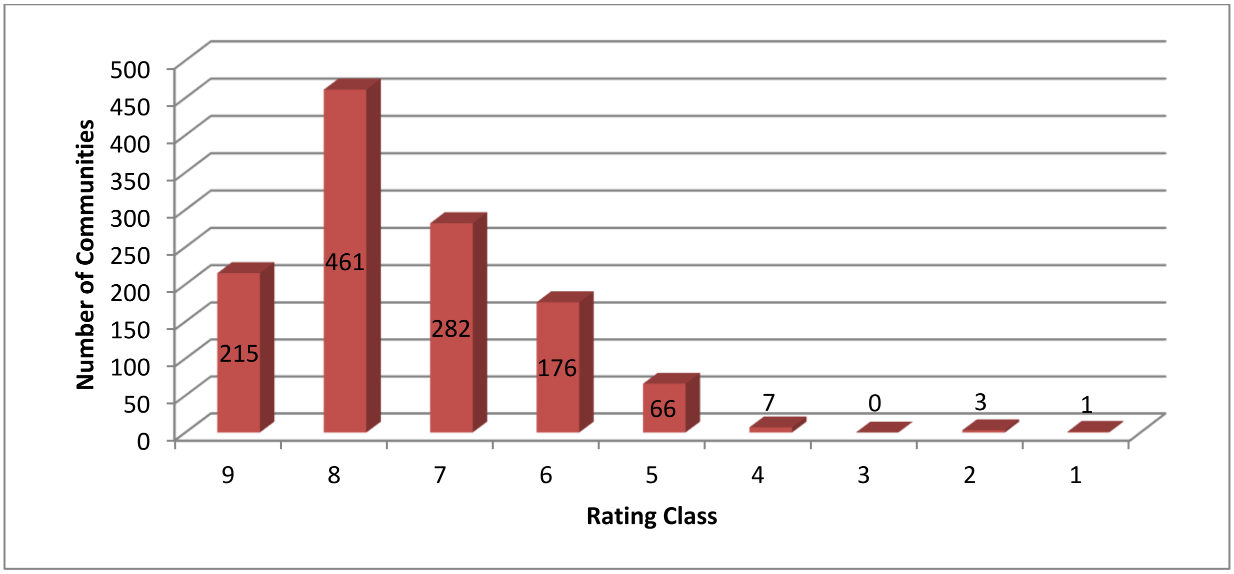


Figure 12-1. CRS Communities by Class Nationwide as of May 2012

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66% of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks.

At this time, neither Las Animas County nor any of the participating communities participate in the CRS program.

12.2 HAZARD PROFILE

Flooding in the county is now predominantly the result of snowmelt and cloudbursts that result in flash flooding. Severe flash flooding poses the greatest risk. These rain events are most often microbursts, which produce a large amount of rainfall in a short amount of time. Flash floods, by their nature, occur suddenly but usually dissipate within hours. Despite their sudden nature, the National Weather Service (NWS) is usually able to issue advisories, watches, and warnings in advance of a flood. In mountainous, rugged terrain, runoff can damage drainage systems or cause them to fail.

The potential for flooding can change and increase through various land use changes and changes to land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities (e.g., development). These changes can also be created by other events such as wildfires. Wildfires create hydrophobic soils, a hardening or "glazing" of the earth's surface that prevents rainfall from being absorbed into the ground, thereby increasing runoff, erosion, and downstream sedimentation of channels.

Potential flood impacts include loss of life, injuries, and property damage. Floods can also affect infrastructure (water, gas, sewer, and power utilities), transportation, jobs, tourism, the environment, and ultimately local and regional economies.

12.2.1 Past Events

The National Centers for Environmental Information Storm Events Database includes flood and flash flood events that happened in Las Animas County between 1996 and 2015, as listed in Table 12-1.

**TABLE 12-1.
LAS ANIMAS COUNTY FLOOD EVENTS (1996-2015)**

			Estimated Damage Cost
Location	Date	Event Type	Property
Kim	6/25/1996	Flood	$0
Upper Purgatoire River Basin/Trinidad and Vicinity	4/30/1999	Flood	$500,000
Upper Purgatoire River Basin/Trinidad and Vicinity	5/1/1999	Flood	$0
Aguilar	8/28/2002	Flash Flood	$0
Stonewall	8/5/2004	Flash Flood	$0
Aguilar	7/25/2006	Flash Flood	$0
Hoehne	5/21/2009	Flash Flood	$10,000
Kim	7/25/2009	Flash Flood	$0
Stonewall	7/25/2010	Flash Flood	$20,000
Weston	7/25/2010	Flash Flood	$20,000
Kim	8/3/2011	Flash Flood	$0
Boncarbo	7/14/2013	Flash Flood	$0
Kim	7/29/2014	Flash Flood	$0
Tobe	7/9/2015	Flash Flood	$0

Source: National Centers for Environmental Information, Storm Events Database

A notable incident causing damages from the Storm Events Database in Las Animas County is described below:

July 25, 2010 – A slow moving thunderstorm produced flash flooding in western Las Animas County. There were several roads north of Highway 12 that sustained erosion due to deep, fast flowing water and caused an estimated $40,000 in property damages in the Stonewall and Weston areas.

According to the USDA's Risk Management Agency, Las Animas County received $195,979 in payments for insured crop losses as a result of excessive moisture and flood events during the timeframe of 2003 to 2015. There were only two years of damaging events in 2013 and 2015 for 1,039 acres affected.

12.2.2 Location

Las Animas County is in the Arkansas River Basin (see Figure 12-2). The Arkansas River originates in the Rocky Mountains near Leadville, Colorado and it flows south-southeast through the mountains before it turns east and enters the plains near Pueblo. The Arkansas River does not flow into Las Animas County, but its tributaries--the Apishapa and Purgatoire Rivers--are the two main watercourses that flow into Las Animas County.

Source: Colorado Geological Survey,http://coloradogeologicalsurvey.org/apps/wateratlas/chapter5_2page1.html

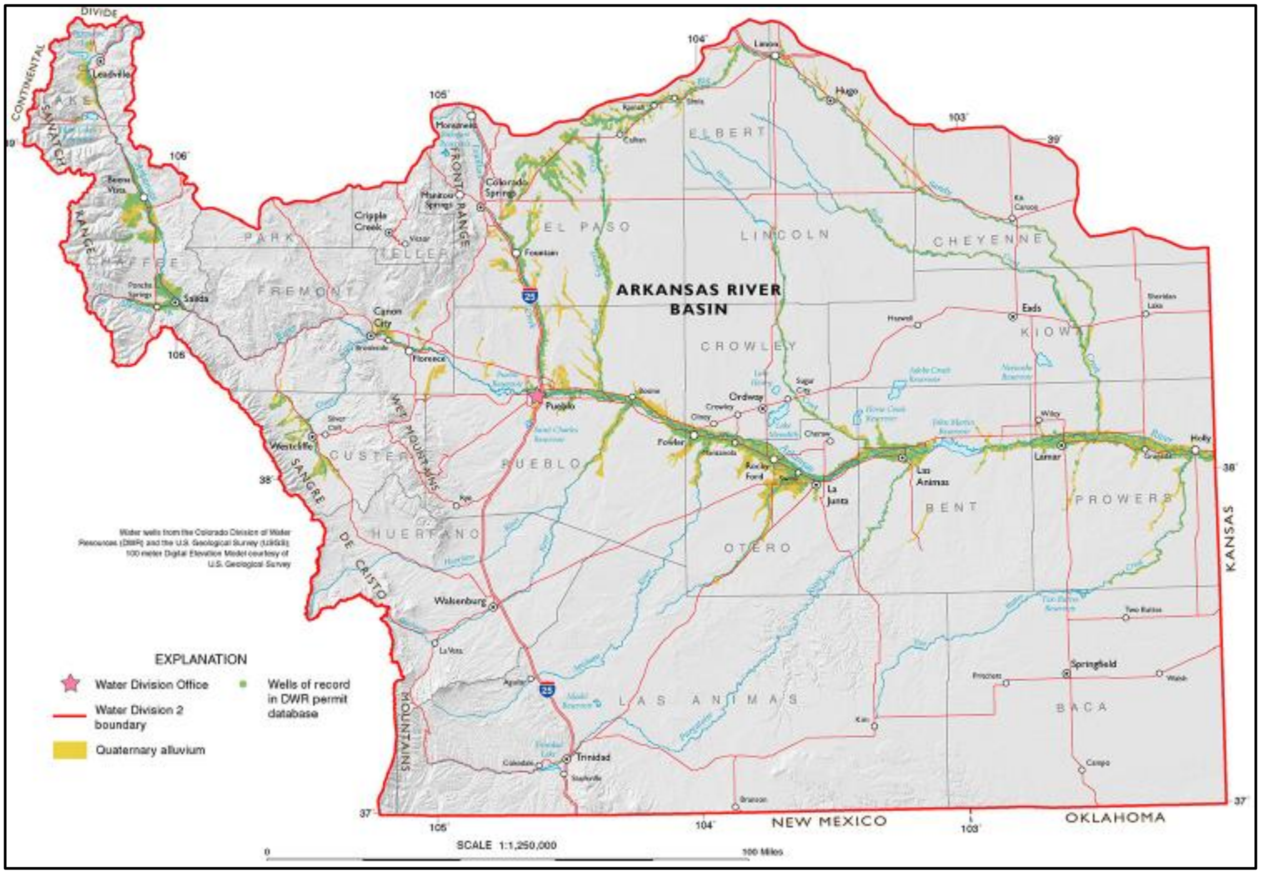


Figure 12-2. Arkansas River Basin

Las Animas County has 30,889 acres in the 100-year floodplain and 41,725 acres in 500-year floodplain. Table 12-2 shows the distribution of the acreage across the jurisdictions of the planning area.

TABLE 12-2.
ACREAGE IN 100-YEAR AND 500-YEAR FLOODPLAIN BY JURISDICTION

	Area (acres)	
Jurisdiction	100-Year	500-Year
Aguilar	0.00	0.00

Cokedale	0.00	0.00
Stonewall FPD	2,761.48	3,340.08
Trinidad	225.37	253.98
Rest of County	27,902.36	38,130.64
Total	**30,889.21**	**41,724.69**

The SFHA in Las Animas County and in the participating communities of Aguilar, Cokedale, SFPD, and Trinidad are shown on Figure 12-3.

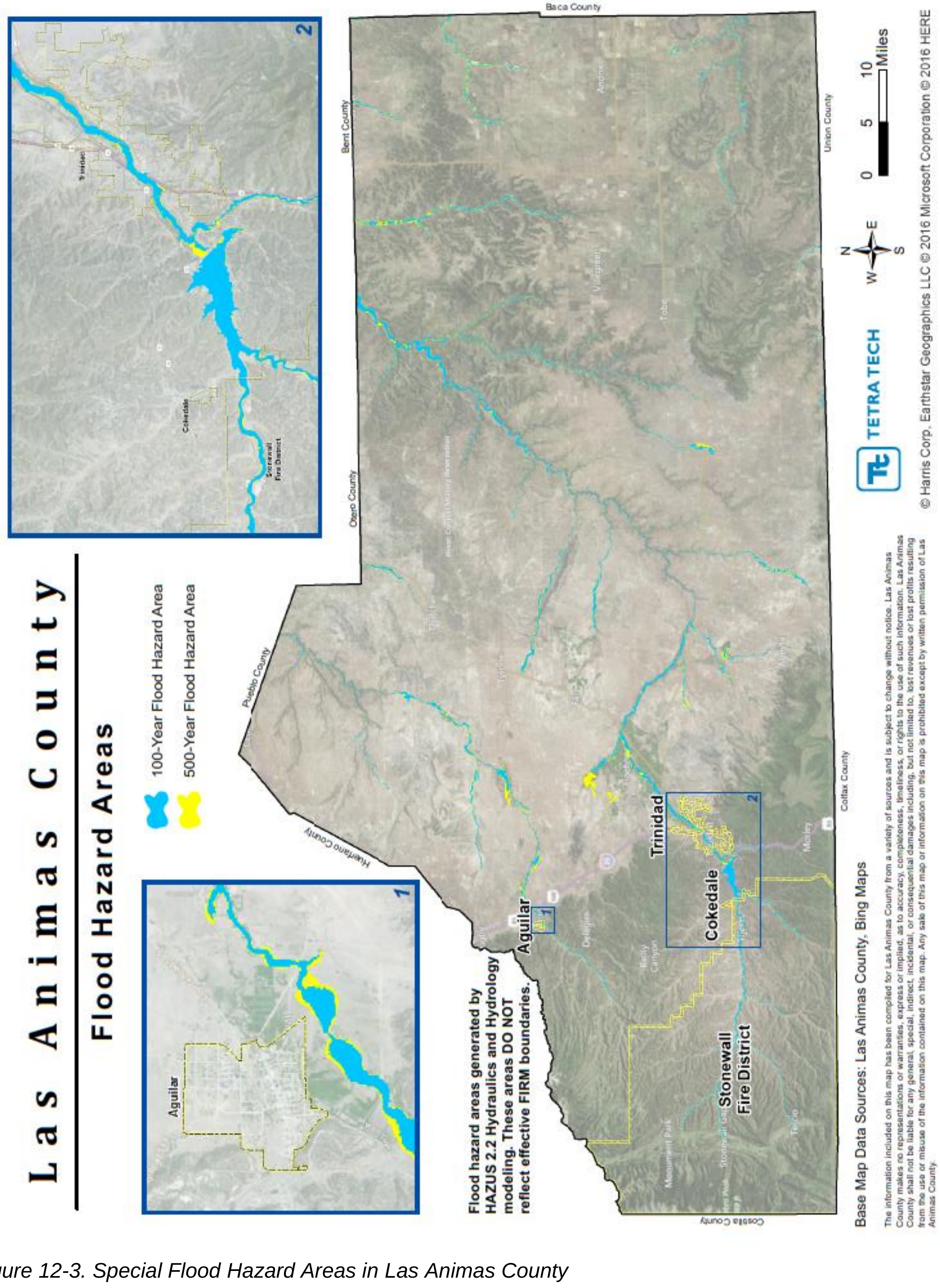


Figure 12-3. Special Flood Hazard Areas in Las Animas County

12.2.3 Frequency and Severity

Flash floods and floods, in Las Animas County, are considered to be moderately likely to occur, with years experiencing high snow in the winter having a greater chance for flood in the spring and summer. This probability is based on the 12 events (events occurring on the same day are considered one event) that have been reported through 2015 (Table 12-1).

Based on the information in this hazard profile, the magnitude/severity of flooding varies for each planning partner. The Towns of Aguilar and Cokedale do not have a SFHA and thus the magnitude is low. Las Animas County has historical flooding issues and the Steering Committee members rank the hazard as moderate, whereas the City of Trinidad Steering Committee members believes that flooding is a high magnitude. The potential for structural damage is the highest for the City of Trinidad (see Table 12-7). The SFPD Steering Committee members believes flooding is a low magnitude hazard.

12.2.4 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Flood warnings are issued by radio and television media, NOAA weather radio, public address systems, emergency sirens, or emergency personnel. Police and fire officials may be on hand to direct evacuations.

The NWS has issued general flood forecasting guidance for the region. Although it can be difficult to predict how much rain will result in a flood event on any given day, there are some general principles regarding when flood events are more likely to occur (NWS 2010):

- If 1 inch or more of rain falls in an urban or mountain area in 1 hour, a flood statement should be issued. In mountain areas, a flash flood warning may be necessary.
- If 2 or more inches of rain falls in an urban or mountain area in 1 hour, a flash flood warning should be issued.
- In rural areas on the plains, if rainfall reaches 2 inches in 1 hour, a flood statement should be issued and if rainfall reaches 3 inches in 1 hour, a flash flood warning should be issued.
- If precipitable water values exceed 150% of normal, this is a good indicator that flash flood-producing rains will develop if precipitation occurs.

12.3 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides and mud flow when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or storm sewers.

12.4 CLIMATE CHANGE IMPACTS

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels, and levees, as well as the design of local sewers and storm drains.

12.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. The model uses 2010 U.S. Census data at the block level and HAZUS 2.2 Hydrology and Hydraulics generated 100 and 500-year floodplain boundaries, which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH default data was enhanced using local geographic information system (GIS) data from county, state and federal sources.

12.5.1 Population

Population counts of those living in the floodplain in the planning area were generated by analyzing the percentage of census block area that intersect with the 100-year and 500-year floodplain boundaries using HAZUS 2.2 Hydrology and Hydraulics model. Total population was estimated by multiplying the percentage of structures in the floodplain by the average persons per household in Las Animas County from the 2015 U.S. Census data. Using this approach, it was estimated that the exposed population for the entire county is 515 within the 100-year floodplain (3.6% of the total county population) and 653 within the 500-year floodplain (4.5% of the total county population).

12.5.2 Property

Present Land Use

Table 12-3 and Table 12-4 show the present land uses in the 100-year and 500-year floodplains for the entire planning area. In the 100-year floodplain, 49.8% of the floodplain is grassland/prairie land and 25.4%

is shrub/scrub land. The remainder is open water, agriculture and forest. The 500-year floodplain is nearly identical to the 100-year floodplain.

TABLE 12-3.
LAS ANIMAS COUNTY PRESENT LAND USE IN 100-YEAR FLOODPLAIN

Present Use Classification	Area (acres)	% of Total
Agriculture	1,160	3.8
Barren Land	2	<0.1
Developed, High Intensity	7	<0.1
Developed, Medium Intensity	35	0.1
Developed, Low Intensity	78	0.3
Developed, Open Space	142	0.5
Forest	913	3.0
Grassland/Prairie	15,376	49.8
Shrub/Scrub	7,849	25.4
Water/Wetlands	5,327	17.2
Total	**30,889**	**100.0**

TABLE 12-4.
LAS ANIMAS COUNTY PRESENT LAND USE IN 500-YEAR FLOODPLAIN

Present Use Classification	Area (acres)	% of Total
Agriculture	1,779	4.3
Barren Land	3	<0.1
Developed, High Intensity	8	<0.1
Developed, Medium Intensity	41	0.1
Developed, Low Intensity	103	0.2
Developed, Open Space	197	0.5
Forest	1,100	2.6
Grassland/Prairie	22,133	53.0
Shrub/Scrub	9,984	23.9
Water/Wetlands	6,377	15.3
Total	**41,725**	**100**

Structures in the Floodplain

Table 12-5 summarizes the total area and number of structures in the 100-year floodplain by municipality and Table 12-6 summarizes the total area and number of structures in the 500-year floodplain by municipality. The HAZUS-MH model determined that there are 271 structures within the 100-year floodplain. Approximately 41% of these structures are in the City of Trinidad. Approximately 79% of the structures are residential. For the 500-year floodplain, there are 341 structures within the floodplain of which approximately 42% of the structures are in the City of Trinidad. Approximately 79% of the structures are residential.

**TABLE 12-5.
STRUCTURES IN THE 100-YEAR FLOODPLAIN**

	Number of Structures in Floodplain							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	**Total**
Aguilar	0	0	0	0	0	0	0	**0**
Cokedale	0	0	0	0	0	0	0	**0**
Stonewall FPD	83	6	2	1	2	0	0	**94**
Trinidad	70	33	4	0	1	1	0	**110**
Rest of County	61	6	1	0	0	0	0	**68**
Total	**214**	**45**	**7**	**1**	**3**	**1**	**0**	**271**

**TABLE 12-6.
STRUCTURES IN THE 500-YEAR FLOODPLAIN**

	Number of Structures in Floodplain							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	**Total**
Aguilar	0	0	0	0	0	0	0	**0**
Cokedale	0	0	0	0	0	0	0	**0**
Stonewall FPD	95	7	2	1	2	0	1	**108**
Trinidad	96	40	5	0	1	1	0	**144**
Rest of County	79	7	1	0	0	0	0	**88**
Total	**271**	**55**	**8**	**2**	**3**	**1**	**1**	**341**

Exposed Value

Table 12-7 summarizes the estimated value of exposed buildings in the planning area in the 100-year floodplain. Table 12-10 summarizes the estimated value of exposed buildings in the planning area in the 500-year floodplain. This methodology estimated $36 million of building-and-contents exposure in the 100-year floodplain and $144 million of building-and-contents exposure in the 500-year floodplain. The 100-year floodplain estimate represent approximately 1.31% of the total estimated replacement value of the planning area and the 500-year floodplain estimate represent approximately 5.14% of the total estimated replacement value of the planning area.

TABLE 12-7. VALUE OF STRUCTURES IN 100-YEAR FLOODPLAIN				
	Value Exposed			% of Total Assessed Value
	Structure	Contents	**Total**	
Aguilar	$0	$0	**$0**	0.00%
Cokedale	$0	$0	**$0**	0.00%
Stonewall FPD	$5,993,000	$8,045,000	**$14,038,000**	4.06%
Trinidad	$5,436,000	$11,393,000	**$16,829,000**	1.03%
Rest of County	$3,124,000	$2,925,000	**$6,049,000**	0.82%
Total	**$14,553,000**	**$22,363,000**	**$36,916,000**	**1.31%**

TABLE 12-8. VALUE OF STRUCTURES IN 500-YEAR FLOODPLAIN				
	Value Exposed			% of Total Assessed Value
	Structure	Contents	**Total**	
Aguilar	$0	$0	**$0**	0.00%
Cokedale	$0	$0	**$0**	0.00%
Stonewall FPD	$28,281,668	$19,014,642	**$47,296,310**	13.68%
Trinidad	$40,408,707	$32,859,328	**$73,268,036**	4.49%
Rest of County	$15,283,145	$9,023,743	**$24,306,888**	3.30%
Total	**$83,973,520**	**$60,897,713**	**$144,871,234**	**5.14%**

12.5.3 Critical Facilities and Infrastructure

Table 12-9 and Table 12-10 summarize the critical facilities and infrastructure (respectively) in the 100-year floodplain of the planning area. The difference between the 100-year and the 500-year floodplain is that there is a total of two protective function facilities and four transportation systems for the SFPD. Details are provided in the following sections.

**TABLE 12-9.
CRITICAL FACILITIES IN THE 100-YEAR FLOODPLAIN**

Facility Type	Medical & Health	Protective Functions	Schools	Government Functions	Hazardous Materials	**Total**
Aguilar	0	0	0	0	0	**0**
Cokedale	0	0	0	0	0	**0**
Stonewall FPD	0	1	0	0	0	**1**
Trinidad	0	0	0	0	0	**0**
Rest of County	0	0	0	0	0	**0**
Total	**0**	**1**	**0**	**0**	**0**	**1**

**TABLE 12-10.
CRITICAL INFRASTRUCTURE IN THE 100-YEAR FLOODPLAIN**

Facility Type	Bridges	Potable Water	Waste Water	Power	Communications	Transportation	Dams	**Total**
Aguilar	0	0	0	0	0	0	0	**0**
Cokedale	0	0	0	0	0	0	0	**0**
Stonewall FPD	0	0	0	0	0	2	0	**2**
Trinidad	0	0	0	0	0	2	0	**2**
Rest of County	0	0	0	0	0	0	0	**0**
Total	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**4**

Utilities and Infrastructure

It is important to identify who may be at risk if infrastructure is damaged by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the county, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. Dikes can fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

Roads

There are no major roads in the planning area that pass through the 100-year floodplain and thus are exposed to flooding.

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. There are two bridges that are in or cross over the 100-year floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

12.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

12.6 VULNERABILITY

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment. The vulnerability analysis was performed at the census-block level. This methodology is likely to overestimate impacts from both the modelled 100-year and 500-year flood events as it is assumed that both structures and the population are evenly spread throughout census block.

12.6.1 Population

A geographic analysis of demographics using the HAZUS-MH model identified populations vulnerable to the flood hazard as follows. These numbers are all calculated assuming that the population/households are evenly distributed over the census blocks.

- **Economically Disadvantaged Populations**—It is estimated that 20.9% of the households within the 100-year floodplain are economically disadvantaged, defined as having household incomes of $20,000 or less.
- **Population over 65 Years Old—**It is estimated that 21.6% of the population in the census blocks that intersect the 100-year floodplain are over 65 years old.
- **Population under 16 Years Old—**It is estimated that 17.3% of the population within census blocks located in or near the 100-year floodplain are under 16 years of age.

The following impacts on persons and households in the planning area were estimated for the 100-year and 500-year flood events through the Level 2 HAZUS-MH analysis:

- 100-year flood event
  - Displaced population = 323
  - Persons requiring short-term shelter = 52
- 500-year flood event
  - Displaced population = 429
  - Persons requiring short-term shelter = 97

12.6.2 Property

HAZUS-MH calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, default inventory data provided with HAZUS-MH. The analysis is summarized in Table 12-11 and Table 12-12. There is a very small difference between the 100- or 500-year FIRMs. It is estimated that there would be up to $36 million of flood loss from a 100-year flood event and up to $52 million from a 500-year event in the planning area. This represents less than 6% of the total exposure to the 100- and 500-year flood and less than 2% of the total replacement value for the county.

TABLE 12-11.
LOSS ESTIMATES FOR 100-YEAR FLOOD EVENT

	Estimated Loss Associated with Flood			% of Total Assessed Value of Jurisdiction
	Structure	Contents	**Total**	
Aguilar	$0	$0	$0	0.00%
Cokedale	$0	$0	$0	0.00%
Stonewall FPD	$5,993,000	$8,045,000	$14,038,000	4.06%
Trinidad	$5,436,000	$11,393,000	$16,829,000	1.03%
Rest of County	$3,124,000	$2,925,000	$6,049,000	0.82%
Total	**$14,553,000**	**$22,363,000**	**$36,916,000**	**1.31%**

TABLE 12-12.
LOSS ESTIMATES FOR 500-YEAR FLOOD EVENT

	Estimated Loss Associated with Flood			% of Total Assessed Value of Jurisdiction
	Structure	Contents	**Total**	
Aguilar	$0	$0	$0	0.00%
Cokedale	$0	$0	$0	0.00%
Stonewall FPD	$8,646,000	$10,851,000	$19,497,000	5.64%
Trinidad	$8,021,000	$15,945,000	$23,966,000	1.47%
Rest of County	$4,667,000	$4,075,000	$8,742,000	1.19%
Total	**$21,334,000**	**$30,871,000**	**$52,205,000**	**1.85%**

National Flood Insurance Program

Table 12-13 provides details on NFIP participation for the communities in the planning area, the number of insurance policies in force, the amount of insurance in force, the number of closed losses, and the total payments for each jurisdiction, where applicable. These statistics help identify vulnerability in the planning area.

**TABLE 12-13.
NFIP PARTICIPATION, POLICY AND CLAIM STATISTICS**

Community Name	NFIP Participant (Yes/No)	Community ID	Current Effective Map Date	Regular-Emergency Program Entry Date	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Las Animas County	Yes	080105#	4/03/1984	9/01/1977	0	0	0	$0
City of Trinidad	Yes	080107#	4/03/1984	7/03/1978	19	$3,570,800	2	$10,992
Town of Aguilar	Yes*	080001#	7/11/1975	8/20/2010 (E)	0	0	0	$0
Town of Cokedale	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

E Emergency Program
N/A Not Applicable
NFIP National Flood Insurance Program
* Yes participant but there is No Special Flood Hazard Area.

Source: NFIP Community Status Book, http://www.fema.gov/cis/CO.html; Bureau Net, http://bsa.nfipstat.fema.gov/reports/reports.html, * Closed losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from January 1, 1978 to June 30, 2016.

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before a FIRM is adopted are more vulnerable to flooding because they do not meet code or are located in hazardous areas.

The following information from flood insurance statistics is relevant to reducing flood risk:

- The use of flood insurance in the planning area is below the national average.
- The average claim paid in the planning area is below the national average.

Repetitive Loss

A repetitive loss property is defined by FEMA and Fiscal Year 2016 (FY2016) Flood Mitigation Assistance (FMA) as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property

Repetitive loss properties make up only 1% to 2% of flood insurance policies in force nationally, yet they account for 40% of the nation’s flood insurance claim payments. In 1998, FEMA reported that the NFIP’s 75,000 repetitive loss structures have already cost $2.8 billion in flood insurance payments and that numerous other flood-prone structures remain in the floodplain at high risk. The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. A recent report on repetitive losses by the National Wildlife Federation found that 20% of these properties are outside any mapped 100-year floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA-sponsored programs, such as the CRS, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

Las Animas County, the City of Trinidad, and the Towns of Aguilar and Cokedale have no FEMA FY2016 FMA-defined repetitive loss or severe repetitive loss properties according to the FEMA definition.

12.6.3 Critical Facilities and Infrastructure

HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, HAZUS-MH correlates these estimates into an estimate of functional down-time (the estimated time it will take to restore a facility to 100% of its functionality). This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery.

The HAZUS critical facility analysis found that, on average, critical facilities would sustain 5.4% damage to the structure and 5.4% damage to the contents during a 100-year flood event. For a 500-year flood event critical facilities, on average, would sustain 5.4% damage to the structure and 5.4% damage to the contents.

12.6.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

12.7 FUTURE TRENDS

Las Animas County and its planning partners are equipped to handle future growth within flood hazard areas. The county and the City of Trinidad have comprehensive plans that address frequently flooded areas and they have committed to linking their comprehensive plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas.

Additionally, the county, City of Trinidad and the Town of Aguilar participants in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. All municipal planning partners have committed to maintaining their good standing under the NFIP through initiatives identified in this plan. Communities considering participation in the CRS program will be able to refine this commitment using CRS programs and templates as a guide.

Urban flooding issues that contribute to flash floods are also a concern in more highly developed areas in Las Animas County. Jurisdictions in the county incorporate stormwater design requirements and rely on the State of Colorado's stormwater permitting program as mandated by the National Pollutant Discharge Elimination System. This program helps jurisdictions apply effective mitigation measures for stormwater runoff.

12.8 SCENARIO

An intense, short-duration storm could move slowly across the planning area, creating significant flash floods with little or no warning. Injuries or fatalities may result if residents are caught off guard by the flood event. Stormwater systems could be overwhelmed and significant flooding could impact a substantial portion of structures within the planning area. Transportation routes could be cut off due to floodwaters, isolating portions of the planning area. These impacts may last after the floodwater recedes as flash floods in the area have been known to cause extensive damage to roadway infrastructure. Areas that have recently experienced wildfires would contribute to the extent of flooding impacts.

12.9 ISSUES

The major issues for flooding are the following:

- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- The duration and intensity of storms contributing to flooding issues may increase due to climate change.
- Flooding may be exacerbated by other hazards, such as wildfires.
- Damages resulting from flood may impact tourism, which may have significant impacts on the local economy.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.

CHAPTER 13.
HAIL, LIGHTNING, AND SEVERE WIND

HAIL, LIGHTNING, AND SEVERE WIND HAZARD RANKING			
	Hail	**Lightning**	**Severe Wind**
Las Animas County	High	Medium	Medium
City of Trinidad	Medium	Medium	Medium
Town of Aguilar	Medium	Low	Low
Town of Cokedale	High	High	Medium
Stonewall Fire Protection District	Medium	Low	Low
See Chapter 18 for more information on hazard ranking.			

DEFINITIONS

Severe Local Storm—Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Windstorm—A storm featuring violent winds. Windstorms tend to damage ridgelines that face into the winds.

13.1 GENERAL BACKGROUND

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a at least 1" diameter, winds gusting in excess of 50 knots (58 mph), or tornado.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air), it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 13-1):

- The *developing stage* of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the *mature stage* when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing

downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.

- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the *dissipating stage*. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

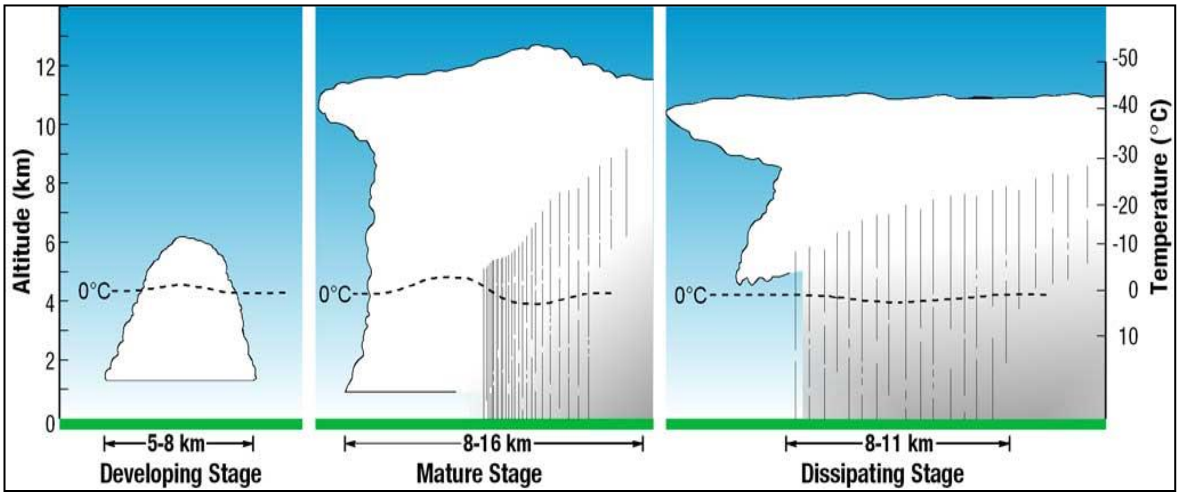


Figure 13-1. Thunderstorm Life Cycle

There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods, and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 mph. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The

rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 mph or more, and strong to violent tornadoes.

13.1.1 Hail

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are “frozen” in place, leaving cloudy ice. Hailstones can have layers like an onion if they travel up and down in an updraft, or they can have few or no layers if they are “balanced” in an updraft. One can tell how many times a hailstone traveled to the top of the storm by counting its layers. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail.

The NWS classifies hail as non-severe and severe based on hail diameter size. Descriptions and diameter sizes are provided in Table 13-1.

TABLE 13-1.
NATIONAL WEATHER SERVICE HAIL SEVERITY

Severity	Description	Hail Diameter Size (in inches)
Non-Severe Hail Does not typically cause damage and does not warrant severe thunderstorm warning from National Weather Service.	Pea	1/4"
	Marble/mothball	1/2"
	Penny	3/4"
	Nickel	7/8"
Severe Hail Research has shown that damage occurs after hail reaches around 1” in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from National Weather Service.	Quarter	1" (severe)
	Half Dollar	1 1/4"
	Walnut/Ping Pong Ball	1 1/2"
	Golf Ball	1 3/4"
	Hen Egg/Lime	2"
	Tennis Ball	2 1/2"
	Baseball	2 3/4"
	Teacup/Large Apple	3"
	Grapefruit	4"
	Softball	4 1/2"

According to the NWS Storm Prediction Center, on average Las Animas County experiences four to five severe hail days a year (Figure 13-2).

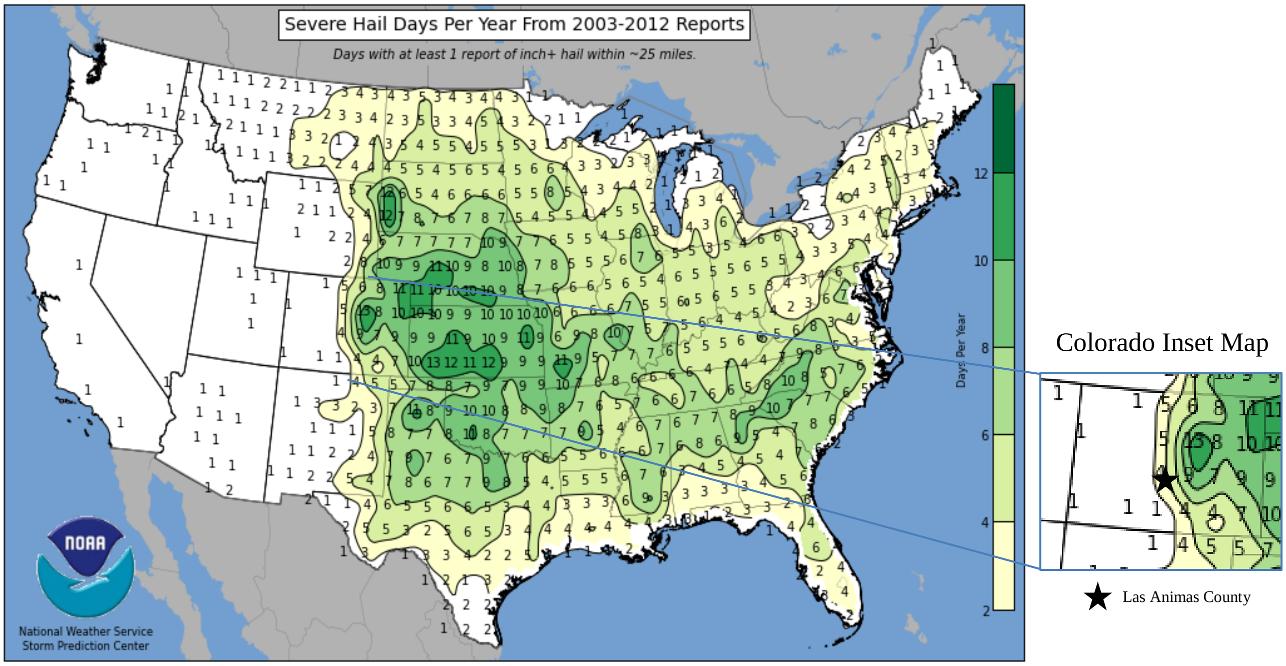


Figure 13-2. Severe Hail Days per Year (2003-2012)

13.1.2 Lightning

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four strokes per flash. The length and duration of each lightning stroke vary, but typically average about 30 microseconds.

Lightning is one of the more dangerous and unpredictable weather hazards in the United States and in Colorado. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines and electrical systems. Lightning also causes forest and brush fires as well as deaths and injuries to livestock and other animals. According to the National Lightning Safety Institute, lightning strikes the U.S. about 25 million times each year and causes more than 26,000 fires nationwide each year. The institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $6 billion per year. Impacts can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or near it.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel can be visible for many miles.

Although not as common, cloud-to-ground lightning is the most damaging and dangerous form of lightning. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm to storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth. Using a network of lightning detection systems, NOAA monitors a yearly average of 25 million strokes of lightning from the cloud-to-ground. Figure 13-3 shows the lightning flash density for the nation.

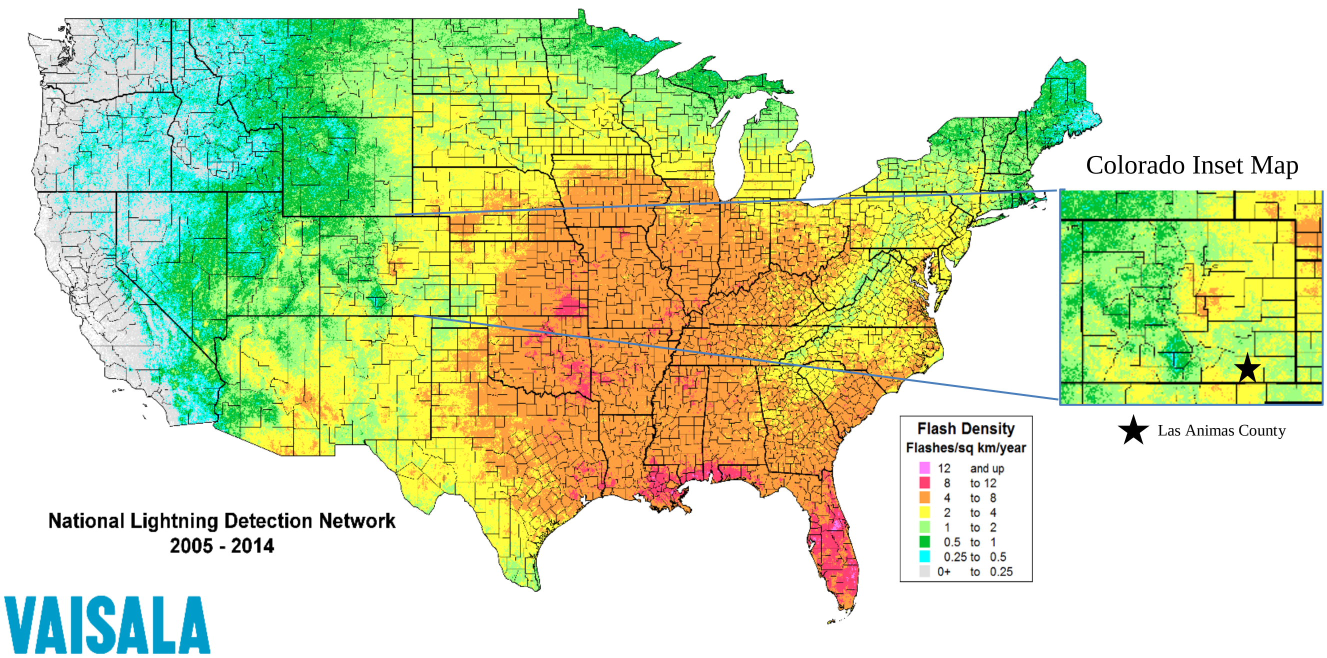


Figure 13-3. National Lightning Detection Network (2005-2014)

Data from the National Lightning Detection Network ranks Colorado 26th in the nation (excluding Alaska and Hawaii) with respect to the number of cloud-to-ground lightning flashes with an average number of more than 500,000 cloud-to-ground lightning strikes per year. According to the National Lightning Detection Network, Las Animas County has approximately 1 to 4 flashes of lightning per square kilometer per year. U.S. lightning statistics compiled by NOAA between 1959 and 1994 indicate that most lightning incidents occur during the summer months of June, July, and August, and during the afternoon hours from between 2 p.m. and 6 p.m.

Figure 13-4 shows state-by-state lightning deaths between 2005 and 2014. Colorado ranks third for the number of deaths at 17. Only Florida, with 47 deaths, and Texas with 20 deaths, had more. In the Rocky Mountains of Colorado, it is common for afternoon thunderstorms during the summer months to occur with lightning strikes at the higher elevations.

Source: National Weather Service, http://www.lightningsafety.noaa.gov/media.shtml

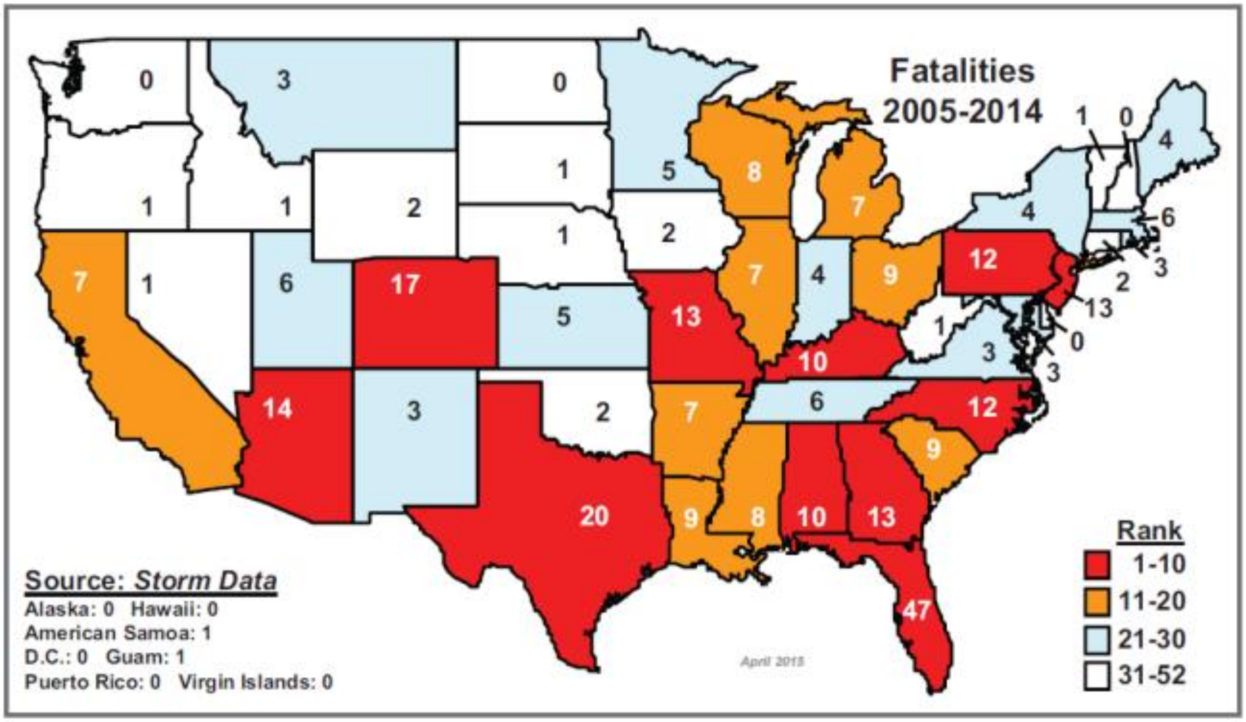


Figure 13-4. Lightning Fatalities in the United States (2005-2014)

13.1.3 Severe Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds**—Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts**—A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts**—A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts**—A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty

winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.

- **Derecho**—A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

13.2 HAZARD PROFILE

13.2.1 Past Events

Hail

The National Centers for Environmental Information Storm Events Database lists 201 hail events in Las Animas County between 1993 and 2015 with only $10,000 in property damages reported in Stonewall from an event on August 15, 2010. These event sizes are noted in Table 13-2.

TABLE 13-2.
LAS ANIMAS COUNTY HAIL EVENTS BY SIZE (1993-2015)

Number of Damaging Hail Events	Maximum Hail Size (inches)
76	0.75
20	0.88
58	1.0
3	1.25
14	1.50
24	1.75
5	2.0
1	2.75

Source: National Centers for Environmental Information

According to the USDA’s Risk Management Agency, there were payments for insured crop losses in Las Animas County as a result of hail events that occurred between 2003 and 2015. Table 13-3 shows that $78,764 in payments were made for 1,324 acres that were affected. The highest hail damage occurred in 2009.

TABLE 13-3.
CROP INSURANCE CLAIMS PAID FROM HAIL (2003-2015)

Crop Year	Commodity	Acres Affected	Indemnity Amount
2003	None	None	None
2004	All crops	309	$12,446
2005	All crops	610	19,877
2006	None	None	None
2007	Wheat	50	$1,662
2008	Wheat	53	$2,305
2009	Wheat	302	$42,474
2010	None	None	None
2011	None	None	None
2012	None	None	None
2013	None	None	None
2014	None	None	None
2015	None	None	None
Total		**1,324**	**$78,764**

Source: USDA Risk Management Agency, http://www.rma.usda.gov/data/cause.html

Lightning

According to the National Centers for Environmental Information Storm Events Database, no lightning events were reported between 1993 and 2015.

Severe Winds

High winds can occur year round in Las Animas County. In the spring and summer, high winds often accompany severe thunderstorms. The varying topography in the area has the potential for continuous and sudden gusting of high winds. According to the State of Colorado Plan, Chinook winds are a fairly common wintertime phenomena in Colorado. These winds develop in well-defined areas and can be quite strong. Atmospheric conditions are expected to continue unchanged with windstorms remaining a perennial occurrence.

Although these high winds may not be life-threatening, they can disrupt daily activities, cause damage to building and structures, and increase the potential damage of other hazards. Wind resource information is shown in Table 13-4 as a proxy for typical wind speeds. Wind resource information is estimated by the National Renewable Energy Laboratory (NREL) to identify areas that are suitable for wind energy applications. The wind resource is expressed in terms of wind power classes, ranging from Class 1 (lowest) to Class 7 (highest). Each class represents a range of mean wind power density or approximate mean wind speed at specified heights above the ground (in this case, 50 meters above the ground surface).

Figure 13-5 shows the wind power class potential density for Las Animas County classified as “Poor” to “Superb.” Table 13-4 identifies the mean wind power density and speed associated with each classification.

TABLE 13-4.
WIND POWER CLASS AND SPEED

	Wind Power Class	Wind Power Density at 50 meters (W/m^2)	Wind Speed at 50 meters (mph)
Poor	1	0-200	0-12.5
Marginal	2	200-300	12.5-14.3
Fair	3	300-400	14.3-15.7
Good	4	400-500	15.7-16.8
Excellent	5	500-600	16.8-17.9
Outstanding	6	600-800	17.9-19.7
Superb	7	800-2000	19.7-26.6

Source: National Renewable Energy Laboratory Wind Energy Resource Atlas of the United States

mph miles per hour
W/m^2 Watts per square meter

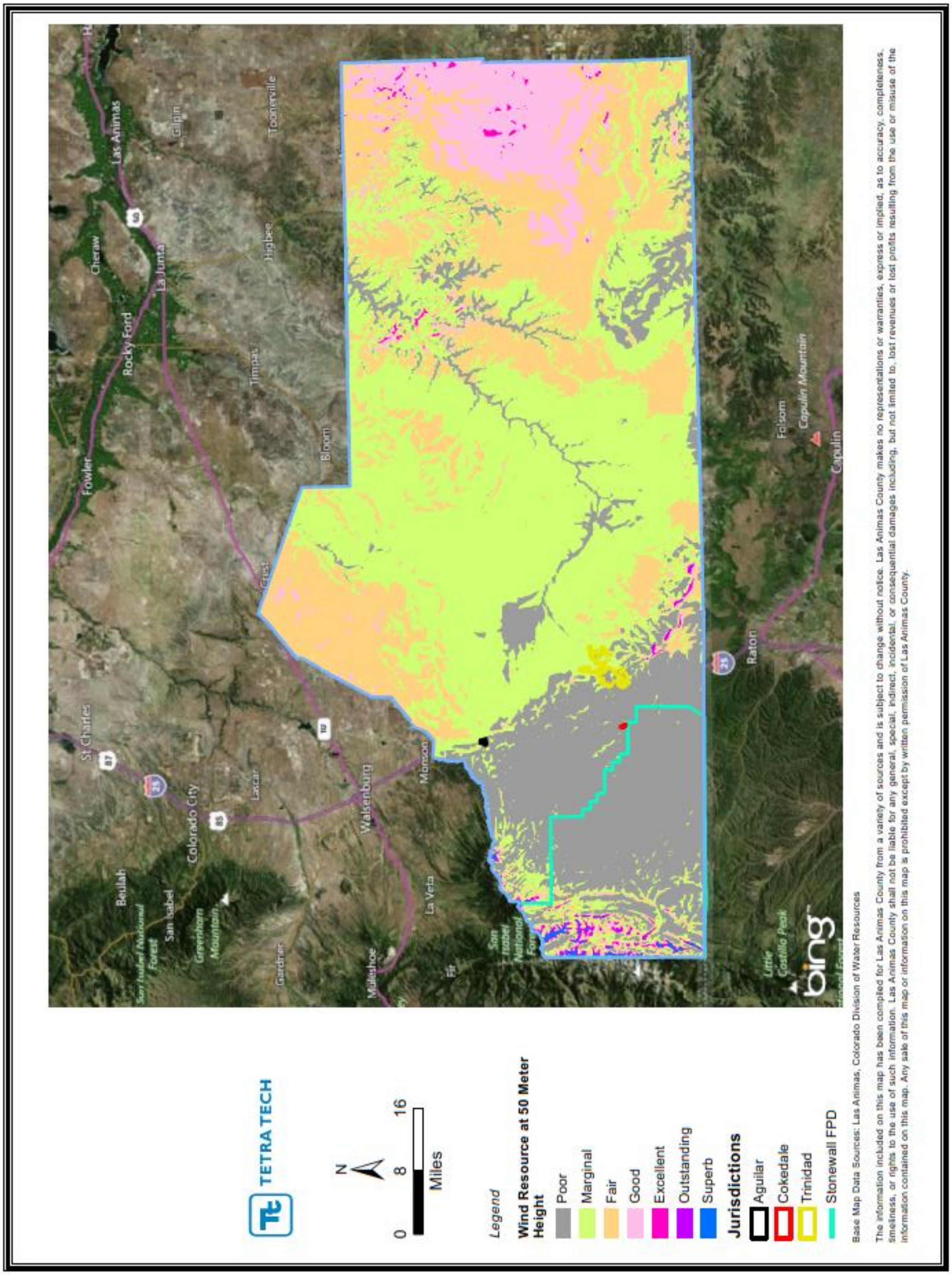


Figure 13-5. Wind Power Resource at 50 Meter Height for Las Animas County

Historical severe weather data from the National Centers for Environmental Information Storm Events Database includes 71 days with high wind events and 20 thunderstorm wind events in Las Animas County between 1993 and December 2015. During this time period there was one death, six injuries and an estimated $661,500 in property damages. Table 13-5 provides a summary of the wind speeds for the reported wind events. Recorded wind gusts ranged from a low of 43 knots to a high of 87 knots.

**TABLE 13-5.
LAS ANIMAS COUNTY REPORTED EVENTS BY WIND SPEED (1993-2015)**

Wind Speed	Number of Events	Wind Speed	Number of Events	Wind Speed	Number of Events
43 knots	1	58 knots	2	71 knots	0
44 knots	0	59 knots	3	72 knots	0
45 knots	0	60 knots	5	73 knots	0
47 knots	0	61 knots	7	74 knots	0
48 knots	0	62 knots	6	75 knots	1
50 knots	12	63 knots	2	76 knots	0
51 knots	7	64 knots	2	77 knots	1
52 knots	30	65 knots	16	78 knots	0
53 knots	4	66 knots	4	79 knots	0
54 knots	5	67 knots	3	80 knots	0
55 knots	1	68 knots	2	85 knots	1
56 knots	6	69 knots	1	86 knots	0
57 knots	2	70 knots	5	87 knots	2

Source: National Centers for Environmental Information

According to the USDA's Risk Management Agency, Las Animas County received $82,930 in payments for insured crop losses as a result of excess wind events that occurred between 2003 and 2015. There were four years of damaging wind events in 2012, 2013, 2014 and 2015 which affected 921 acres of dry beans and wheat.

13.2.2 Location

Severe hail, wind, and lightning events have the potential to happen anywhere in the planning area.

Hail

Previous instances of hail events in Las Animas County are shown in Figure 13-6.

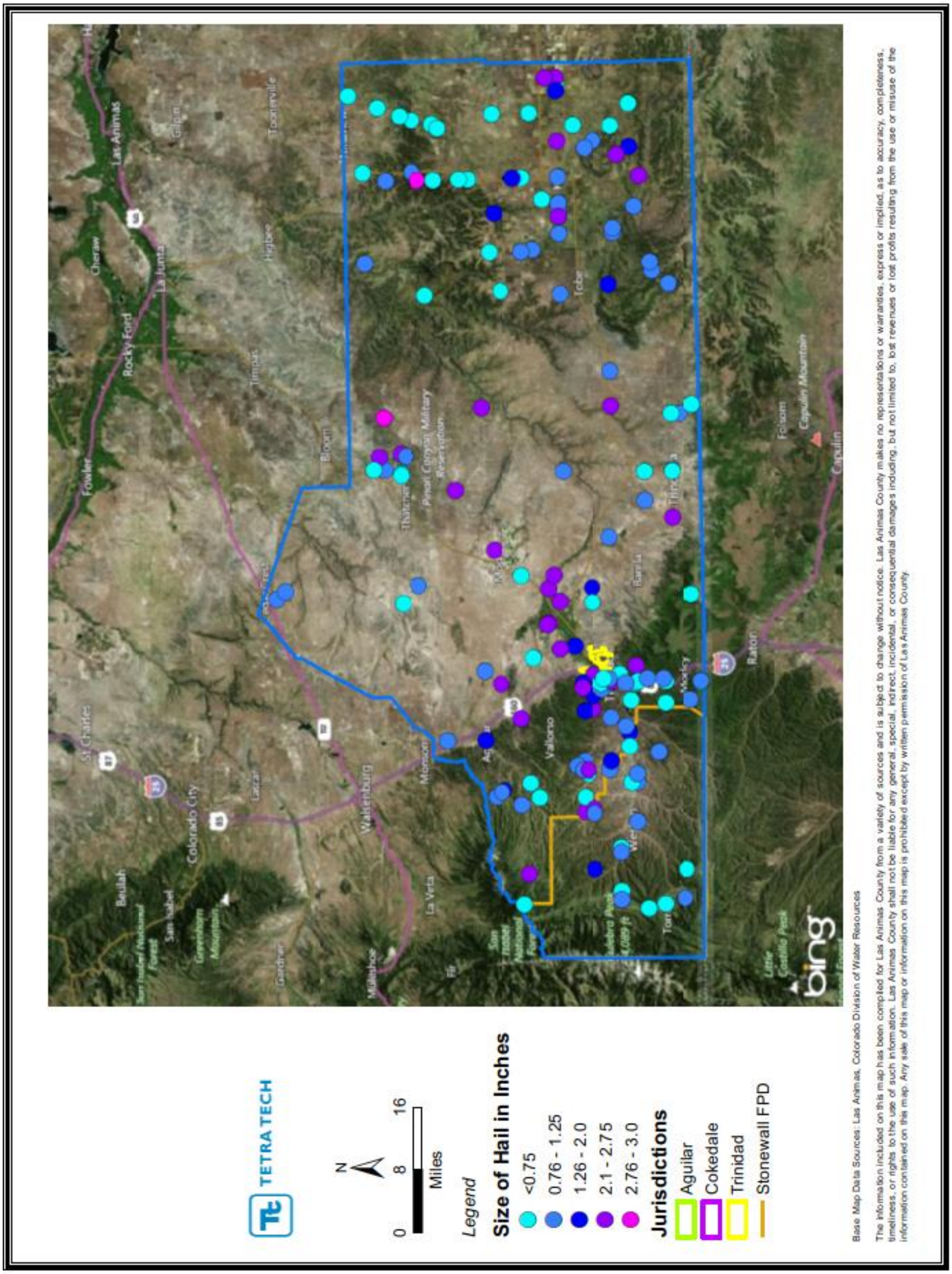


Figure 13-6. Hail Events in Las Animas County

Lightning

The entire extent of Las Animas County is exposed to some degree of lightning hazard, though exposed points of high elevation have significantly higher frequency of occurrence. Since lightning accompanies thunderstorms, it can be assumed that lightning occurs even though events have not been reported.

Severe Winds

Windstorms could occur anywhere in Las Animas County. They have the ability to cause damage over 100 miles from the center of storm activity. Higher elevations could experience the most significant wind speeds, but these areas are generally not developed or populated. Wind events are most damaging to areas that are heavily wooded. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail.

13.2.3 Frequency and Severity

The nation has experienced severe storms (wind, tornado, hail) that are occurring with more intensity and affecting more areas of the country. While scientists debate why these storms occur, no one argues with their effects—extensive property damage and, many times, loss of life. The property damage can be as minimal as a few broken shingles to total destruction of buildings.

Hail

Severe hailstorms can be quite destructive. Much of the damage inflicted by hail is to crops. In recent years in the United States, hail caused more than $1.3 billion in damage to property and crops each year. This represents 1% to 2% of the annual crop value. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans and occasionally has been fatal.

Based on the information in this hazard profile, the overall significance of hail events is medium to high. The Steering Committee members for Las Animas County and the Town of Cokedale rated hail as a high hazard, and the City of Trinidad, Town of Aguilar, and the SFPD rated hail as a medium hazard.

Lightning

Since lightning accompanies thunderstorms, it can be assumed that lightning occurs more often than damages are reported.

The relationship of lightning to wildfire ignitions in the county increases the significance of this hazard. Lightning strikes are more likely at higher elevations, such as mountain peaks and may pose a threat to hikers, climbers, and other recreational users in the county. Based on the information in this hazard profile, the overall significance of lightning events is moderate. The Steering Committee members for the Town of Cokedale rated the hazard as high. Las Animas County and the City of Trinidad rated the hazard as moderate. The Town of Aguilar and the SFPD rated lightning as a low hazard.

Severe Winds

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Wind storms in Las Animas County are rarely life threatening, but do disrupt daily activities, cause damage to buildings, and structures, and increase the potential for other hazards, such as wildfire. Winter winds can also cause damage, close highways (blowing snow), and induce avalanches. Winds can also cause trees to fall, particularly those killed by pine beetles or wildfire, creating a hazard to property or those outdoors.

Based on the information in this hazard profile, the magnitude/severity of severe winds is considered moderate and the overall significance is considered to have a moderate potential impact. The Steering

Committee members for Las Animas County, the City of Trinidad and the Town of Cokedale rated the hazard as moderate. The Town of Aguilar and the SFPD rated severe wind as a low hazard.

13.2.4 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. Weather forecasts for the planning area are limited. At times warning for the onset of severe weather may be limited.

13.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Fires can occur as a result of lightning strikes. Many locations in the region have minimal vegetative ground cover and the high winds can create a large dust storm, which becomes a hazard for travelers and a disruption for local services. High winds in the winter can turn small amount of snow into a complete whiteout and create drifts in roadways. Debris carried by high winds can also result in injury or damage to property. A wildland fire can be accelerated and rendered unpredictable by high winds, which makes a dangerous environment for firefighters.

13.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 13-7). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

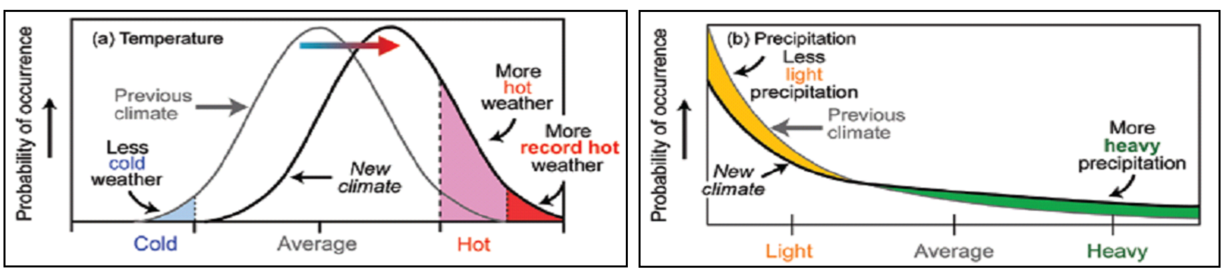


Figure 13-7. Severe Weather Probabilities in Warmer Climates

13.5 EXPOSURE

13.5.1 Population

It can be assumed that the entire planning area is exposed to some extent to thunderstorm, lightning, high wind, and hail events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding. It is not uncommon for residents living in more remote areas of the county to be isolated after such events.

13.5.2 Property

According to the Las Animas County Assessor, there are 14,232 buildings that define the planning area. Most of these buildings are residential. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage.

All of these buildings are considered to be exposed to the thunderstorm, lightning, wind, and hail hazard, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

13.5.3 Critical Facilities and Infrastructure

Facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with these weather events are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to secondary hazards such as landslides.

13.5.4 Environment

The environment is highly exposed to lightning, winds, and hail. Natural habitats such as streams and trees risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events can produce river channel migration or damage riparian habitat.

13.6 VULNERABILITY

13.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during thunderstorm, wind, and hail events and could suffer more secondary effects of the hazard. Hikers and climbers in the area may also be more vulnerable to severe weather events. Visitors to the area may not be aware of how quickly a thunderstorm can build in the mountains.

13.6.2 Property

All property is vulnerable during thunderstorm, lightning, wind, and hail events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Generally, damage is minimal and goes unreported. Property located at higher elevations and on ridges may be more prone to wind damage. Property located under or near overhead lines or near large trees may be damaged in the event of a collapse.

Hail

A total of 201 hail events have taken place in Las Animas County between 1993 and 2015. The loss estimates for the hail events for the planning partners are listed in Table 13-6.

TABLE 13-6. LOSS ESTIMATES FOR HAIL EVENTS IN LAS ANIMAS COUNTY			
Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Trinidad	1.70 event/year	$0/event	$0/event
Aguilar	0.65 event/year	$0/event	$0/event
Cokedale	0.26 event/year	$0/event	$0/event
Stonewall FPD	Not available	Not available	Not available
Rest of the County	6.21 event/year	$10,000/event	$434
Entire Las Animas County	**8.7 event/year**	**$7,143/event**	**$2,143**

Note: Loss estimates based on historical record of 1 loss events and 201 total events.
Source: NOAA National Centers for Environmental Information. 1993-2015.

Lightning

No lightning events have been recorded in Las Animas County.

Severe Winds

A total of 91 days of severe wind events have taken place in Las Animas County between 1993 and 2015. The loss estimates for severe wind events for Las Animas County are listed in Table 13-7.

TABLE 13-7. LOSS ESTIMATES FOR SEVERE WIND EVENTS IN LAS ANIMAS COUNTY			
Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Las Animas County	4 events/year	$110,250/event	$28,760

Note: Loss estimates based on historical record of 91 wind-related events.
Source: NOAA National Centers for Environmental Information. 1993-2015.

13.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from thunderstorms, wind, and hail, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Prolonged obstruction of major routes due to landslides, debris, or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region. Severe windstorms and downed trees can create serious impacts on power and above-ground communication lines. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Lightning events in the county can have destructive effects on power and information systems.

Failure of these systems would have cascading effects throughout the county and could possible disrupt critical facility functions.

13.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure, discussed in Chapter 13.5.4.

13.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The municipalities have adopted the International Building Code. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in master plans and enforced through zoning code and the permitting process also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

13.8 SCENARIO

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards of flood and landslide occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding, drifting snow, and landslides could further obstruct roads and bridges, further isolating residents.

13.9 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- The potential for isolation after a severe storm event is high.
- The lack of proper management of trees may exacerbate damage from high winds.

CHAPTER 14. LANDSLIDE, MUD/DEBRIS FLOW, ROCKFALL

LANDSLIDE, MUD/DEBRIS FLOW, ROCKFALL HAZARD RANKING	
Las Animas County	Low
City of Trinidad	Low
Town of Aguilar	Low
Town of Cokedale	Low
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Landslide—The sliding movement of masses of loosened rock and soil down a hillside or slope. Such failures occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)—A river of rock, earth, organic matter and other materials saturated with water.

14.1 GENERAL BACKGROUND

14.1.1 Landslide

A landslide is a general term for a variety of mass-movement processes that generate a downslope movement of soil, rock, and vegetation under gravitational influence. Some of the natural causes of ground instability are stream and lakeshore erosion, heavy rainfall, and poor quality natural materials. In addition, many human activities tend to make the earth materials less stable and, thus, increase the chance of ground failure. Human activities contribute to soil instability through grading of steep slopes or overloading them with artificial fill, by extensive irrigation, construction of impermeable surfaces, excessive groundwater withdrawal, and removal of stabilizing vegetation. Landslides typically have a slower onset and can be predicted to some extent by monitoring soil moisture levels and ground cracking or slumping in areas of previous landslide activity.

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 30%.
- A history of landslide activity or movement during the last 10,000 years.
- Stream or wave activity, which has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments.
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Figure 14-1 through Figure 14-4 show common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

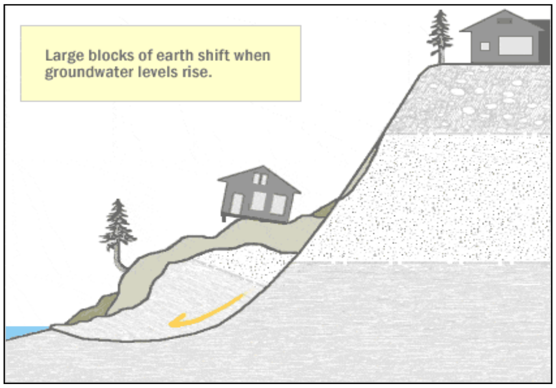


Figure 14-1. Deep Seated Slide

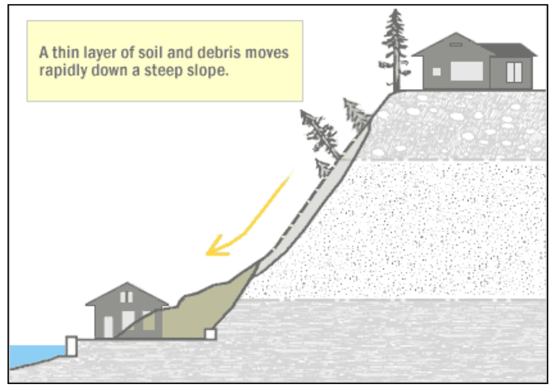


Figure 14-2. Shallow Colluvial Slide

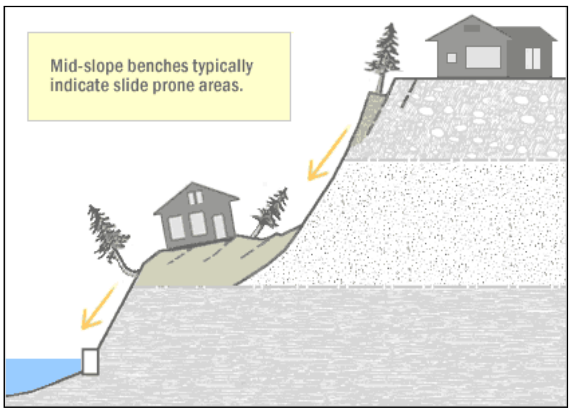


Figure 14-3. Bench Slide

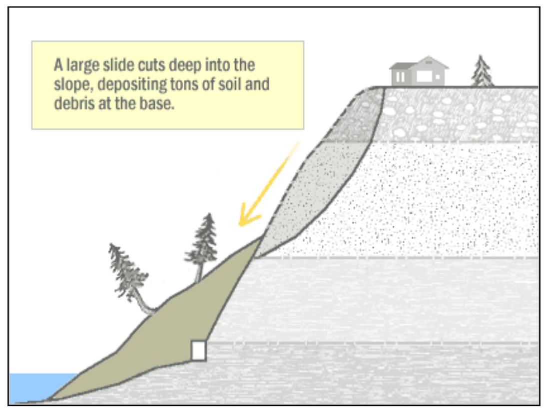


Figure 14-4. Large Slide

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

14.1.2 Mud and Debris Flow

According to the Colorado Geological Survey, a mudslide is a mass of water and fine-grained earth that flows down a stream, ravine, canyon, arroyo, or gulch. If more than half of the solids in the mass are larger than sand grains (rocks, stones, boulders), the event is called a debris flow. A debris fan is a conical landform produced by successive mud and debris flow deposits, and the likely spot for a future event. Mud and debris flow problems can be exacerbated by wildfires that remove vegetation that serves to stabilize soil from erosion. Heavy rains on the denuded landscape can lead to rapid development of destructive mudflows.

14.1.3 Rockfall

A rockfall is the falling of a detached mass of rock from a cliff or down a very steep slope. Weathering and decomposition of geological materials produce conditions favorable to rockfalls. Rockfalls are caused by the loss of support from underneath through erosion or triggered by ice wedging, root growth, or ground shaking. Changes to an area or slope such as cutting and filling activities can also increase the risk of a rockfall. Rocks in a rockfall can be of any dimension, from the size of baseballs to houses. Rockfalls can threaten human life, impact transportation corridors and communication systems and result in other property damage. Spring is typically the landslide/rockfall season in Colorado as snow melts and saturates soils and temperatures enter into freeze/thaw cycles. Rockfalls and landslides are influenced by seasonal patterns, precipitation and temperature patterns. Earthquakes could trigger rockfalls and landslides too.

14.2 HAZARD PROFILE

14.2.1 Past Events

The National Centers for Environmental Information does not list any landslide events that impacted Las Animas County between 1993 and 2015. According to the USGS, there have not been any recorded landslide events in Las Animas County.

14.2.2 Location

According to the *2013 Colorado Natural Hazards Mitigation Plan*, "Many of Colorado's landslides occur along transportation networks because soil and rock along the transportation corridor has been disturbed by roadway construction. Construction along roads can occur with or without proper landslide hazard mitigation procedures. The cost to maintain, cleanup, monitor, and repair roads and highways from landslide activity is difficult to assess, but the best records come from CDOT, which is responsible for maintaining Colorado roads and highways" (Colorado Division of Emergency Management 2015).

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding. The geographic location of landslides and rockfalls throughout Las Animas County is isolated. Figure 14-5 shows mapped landslide hazard areas within the county. Of the participating jurisdiction in Las Animas County, the county is the most likely jurisdiction to be impacted by landslides, mud/debris flows, or rockfalls.

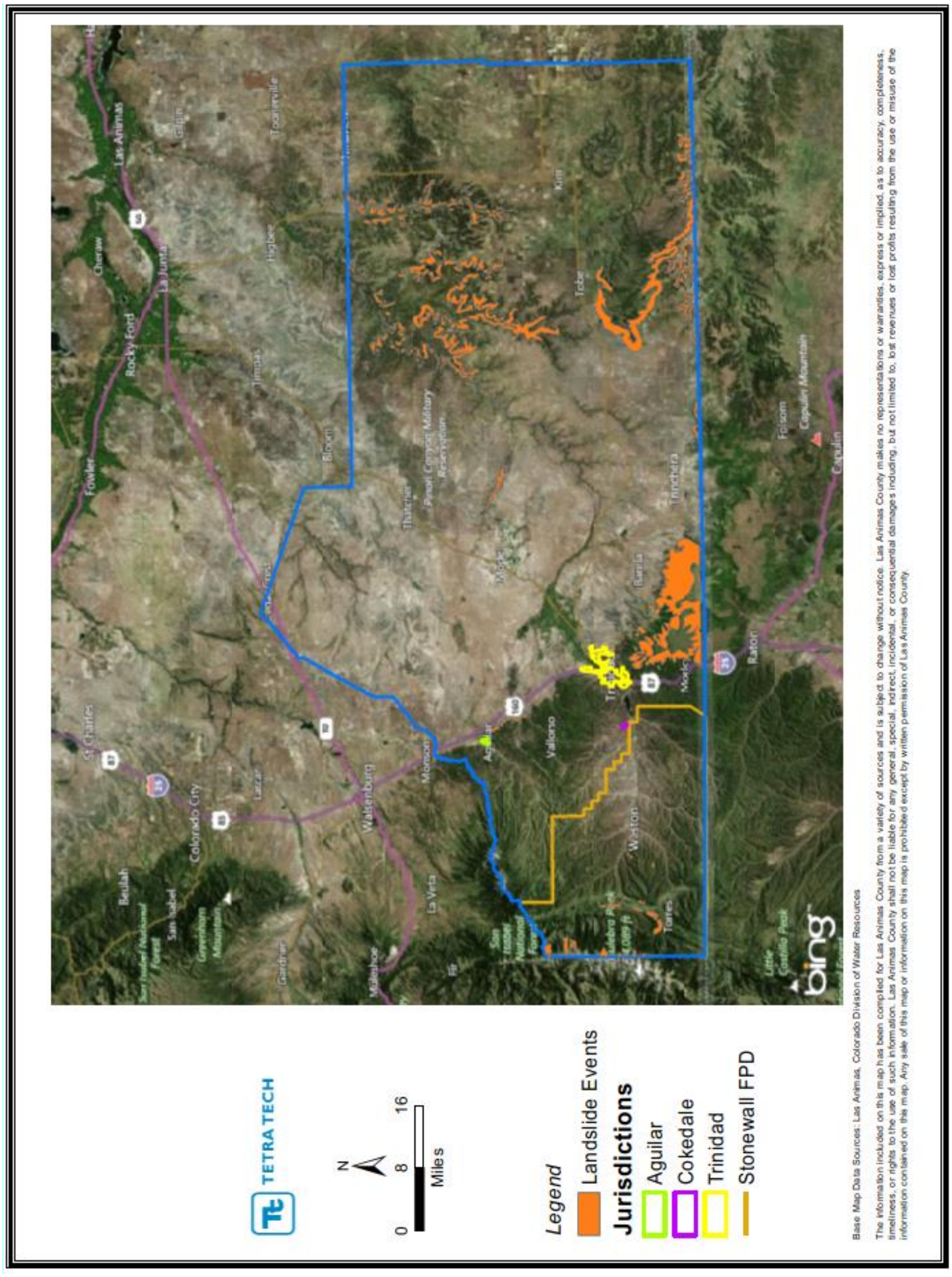


Figure 14-5. Landslide Events in Las Animas County

14.2.3 Frequency and Severity

Landslides destroy property and infrastructure and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost of about $1.5 billion. Based on this hazard profile, the magnitude/severity of a landslide/rock fall event in Las Animas County is low because of the remote location of most landslide events. However, the frequency of landslide events within the county are difficult to ascertain due to a lack of information regarding past events.

All the Steering Committee members rated landslides, mud debris flow, and rockfall hazards as low.

14.2.4 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to identify what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements, or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased soil content
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows and visible gaps indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

14.3 SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. More significantly, landslides can limit the ability of emergency response services to access and serve portions of the county. Additionally, rockfalls to rivers can cause blockages causing flooding, damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents.

14.4 CLIMATE CHANGE IMPACTS

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increases in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

14.5 EXPOSURE

Exposure and vulnerability estimates for the landslide hazard were assessed using a methodology based on large assumptions. Most of the landslide risk areas in the county are outside of population centers.

14.5.1 Population

Population exposure to landslide hazard areas is likely limited. The only mapped hazard areas are in the western and southern portions of the county. It is most likely that individuals exposed to landslide, mud/debris flow, and rockfall hazards would be in recreation areas or driving on roadways.

14.5.2 Property

Property exposure to landslide hazard areas are likely to be minimal. As stated previously, the only mapped hazard areas within incorporated jurisdictions are in the western and southern portions of the county.

14.5.3 Critical Facilities and Infrastructure

No loss estimation of these facilities was performed due to the lack of established damage functions for the landslide hazard. A significant amount of infrastructure can be exposed to mass movements:

- **Roads—**Landslides, mud/debris flow, or rockfalls can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes; the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.

14.5.4 Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time.

14.6 VULNERABILITY

14.6.1 Population

In general, all person exposed to landslide hazard areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

14.6.2 Property

Loss estimations for the landslide hazards are not based on modeling using damage functions, because no such damage functions have been generated. There are no reports of property damage in association with landslides, mud/debris flows, and rockfalls in Las Animas County. Areas of higher susceptibility are mainly located away from population centers in the mountainous areas.

14.6.3 Critical Facilities and Infrastructure

No critical facilities are found in the highest landslide prone areas of the county. Several critical facilities are in areas that have the potential for landslides, mud/debris flows, and rockfalls. A more in-depth analysis of the mitigation measures taken by these facilities to prevent damage from mass movements should be done to evaluate whether they could withstand impacts of a mass movement.

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer and power infrastructure. Highly susceptible areas of the county include mountain roads and transportation infrastructure. At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

14.6.4 Environment

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard, discussed in Section 15.5.4.

14.7 FUTURE TRENDS IN DEVELOPMENT

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. The mountainous topography of the county presents considerable constraints to development, most commonly in the form of steeply sloped areas. These areas are vulnerable to disturbance and can become unstable. Most of these areas are adjacent to roadway systems that are heavily used.

Continued adherence to the land development codes and regulations in the planning area will decrease the risk of future development to landslide hazard areas. Development of lands within identified hazard areas are limited to meet the requirements set forth by the planning and zoning offices or the building departments of the jurisdiction at the time of construction. Most construction has been limited to areas that are not in these hazard areas.

14.8 SCENARIO

Major landslides in the planning area occur as a result of soil conditions that have been affected by wildfire, natural erosion, severe storms, groundwater, or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding in burn scar areas. Landslides are most likely during late spring and summer months. After heavy spring and summer rains, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Burn scars, gravity, poor drainage, a rising groundwater table, and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of town centers and into areas less developed in terms of infrastructure. Most mass movements would be isolated events affecting specific areas. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines and knock out transportation corridors through the county. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power, and communication access to residents.

14.9 ISSUES

Important issues associated with landslides in the planning area include the following:

- There are most likely existing homes in landslide risk areas throughout the county. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- As incidents of wildfires increase and hillsides are void of vegetation, rain-soaked hillsides are more likely to slide resulting in increased damage countywide.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

CHAPTER 15.
TORNADO

TORNADO RANKING	
Las Animas County	Medium
City of Trinidad	Medium
Town of Aguilar	Low
Town of Cokedale	Low
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5, or the Enhanced Fujita Scale.

15.1 GENERAL BACKGROUND

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can form from individual cells within severe thunderstorm squall lines. They also can form from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

In 2007, the NWS began rating tornadoes using the Enhanced Fujita Scale (EF-scale). The EF-scale is a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed in Table 15-1. These estimates vary with height and exposure. Standard measurements are taken by weather stations in open exposures. Table 15-2 describes the EF-scale ratings versus the previous Fujita Scale used prior to 2007 (NOAA 2007).

The U.S. experiences more tornadoes than any other country. In a typical year, approximately 1,000 tornadoes affect the U.S. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S. Figure 15-1 shows the annual average number of tornadoes between 1991 and 2010. Colorado experienced an average of 53 tornado events annually in that period. Colorado ranks 9th among the 50 states in frequency of tornadoes, but 38th for the number of deaths. Colorado ranks 31st for injuries and 30th for the cost of repairing the damages due to tornadoes. When these statistics are compared to other states by the frequency per square mile, Colorado ranks 28th for injuries per area and 37th for costs per area.

A study from NOAA's National Severe Storms Laboratory used historical data to estimate the daily probability of tornado occurrences across the U.S., regardless of tornado magnitude.

TABLE 15-1.
ENHANCED FUJITA SCALE DAMAGE INDICATORS

No.	Damage Indicator	No.	Damage Indicator
1	Small barns, farm outbuildings	15	School – 1-story elementary (interior or exterior halls)
2	One or two-family residences	16	School – junior or senior high school
3	Single-wide mobile home	17	Low-rise (1-4 story) building
4	Double-wide mobile home	18	Mid-rise (5-20) building
5	Apt, condo, townhouse (3 stories or less)	19	High-rise (over 20 stories) building
6	Motel	20	Institutional bldg. (hospital, govt. or university)
7	Masonry apt. or motel	21	Metal building system
8	Small retail building (fast food)	22	Service station canopy
9	Small professional (doctor office, bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated (big box) retail building	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree – hardwood
14	Automobile service building	28	Tree – softwood

TABLE 15-2.
THE FUJITA SCALE AND ENHANCED FUJITA SCALE

Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gusts (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Notes:
EF Enhanced Fujita
F Fujita
mph Miles per Hour

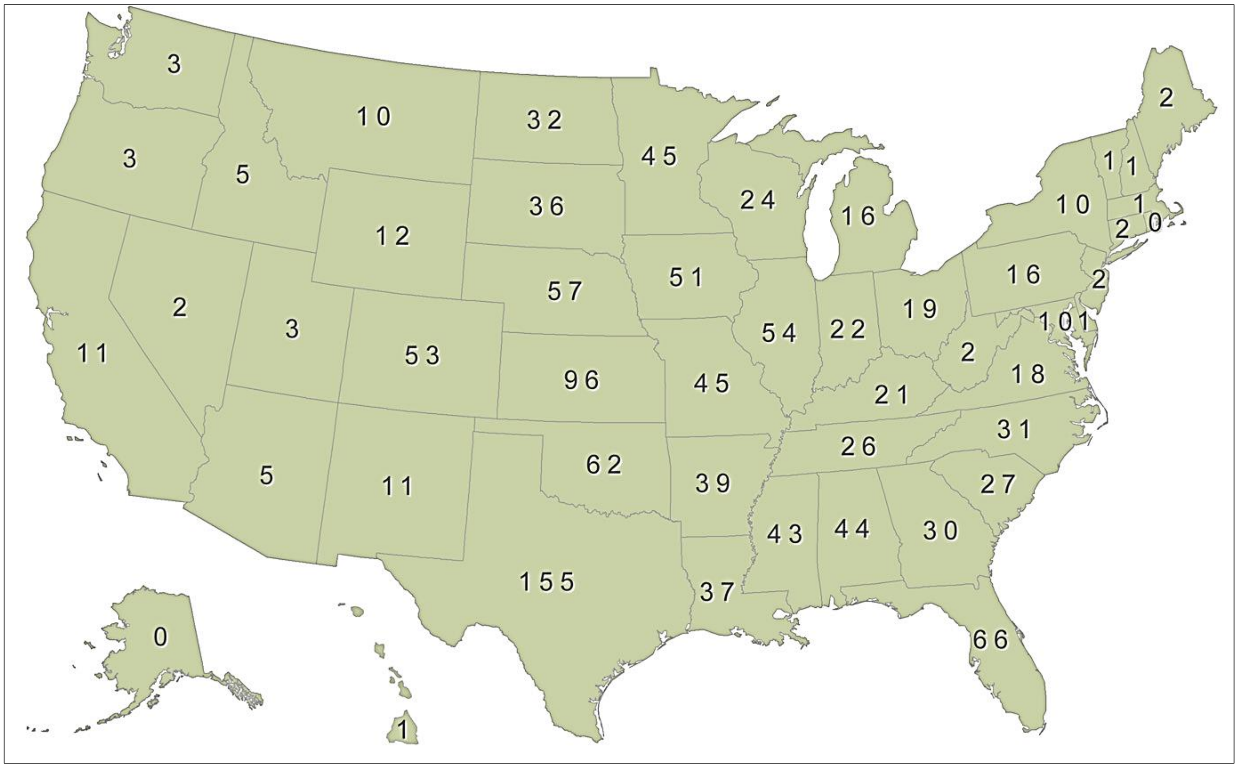


Figure 15-1. Annual Average Number of Tornadoes in the U.S. (1991-2010)

15.2 HAZARD PROFILE

15.2.1 Past Events

Table 15-3 lists nine tornadoes in Las Animas County recorded by the NOAA storm prediction center from 1954 to 2015 that caused $298,060 in property damages. However, a total of 29 tornadoes have been reported in Las Animas County.

TABLE 15-3.
TORNADOES IN LAS ANIMAS COUNTY (1954-2015)

Date	Tornado Rating	Injuries	Property Damage	Tornado Length (miles)	Tornado Width (yards)
5/24/1965	F1	0	$2,500	0	33
6/16/1965	F1	0	$2,500	0	33
6/10/1983	F1	0	$30	0.5	37
6/10/1983	F1	0	$30	0.5	37
6/06/1991	F0	0	$250,000	0.4	100
6/07/1998	F1	0	$30,000	3	200
5/28/2001	F0	0	$5,000	0.1	30
6/06/2014	EF1	1	$5,000	8.58	400
6/06/2014	EF1	0	$3,000	1.35	100

TABLE 15-3.
TORNADOES IN LAS ANIMAS COUNTY (1954-2015)

Date	Tornado Rating	Injuries	Property Damage	Tornado Length (miles)	Tornado Width (yards)

Notes:
EF Enhanced Fujita
F Fujita

15.2.2 Location

Figure 15-2 shows the locations of the 29 previous tornado events throughout the county.

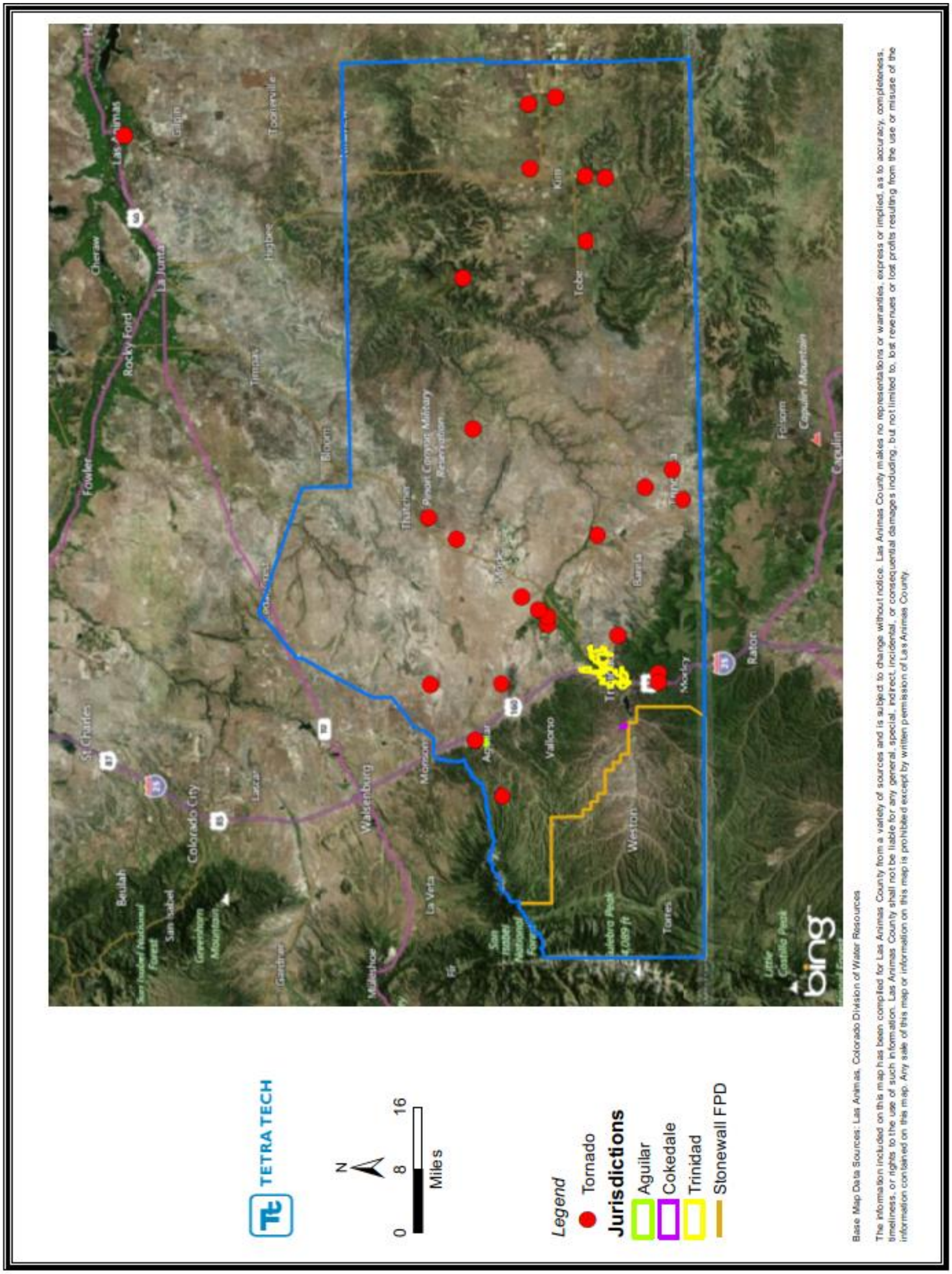


Figure 15-2. Historical Tornado Locations in Las Animas County

15.2.3 Frequency and Severity

Tornadoes have been reported 9 months of the year in Colorado, with peak occurrences between May through August. Statewide, June is by far the month with the most recorded tornadoes. There have been 29 tornadoes recorded in Las Animas County from 1954 to 2015 for an average of 0.47 tornadoes per year.

Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike within the populated areas of Las Animas County, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. Historically, tornadoes have not typically been severe in the planning area.

Based on the information in this hazard profile, the overall significance of tornadoes in Las Animas County is low to moderate. The Steering Committee members rated it a low hazard for the Towns of Aguilar and Cokedale, and the SFPD. The committee rated it a medium hazard for Las Animas County and the City of Trinidad.

15.2.4 Warning Time

The NOAA's storm prediction center issues tornado watches and warnings for Las Animas County:

- **Tornado Watch—**Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- **Tornado Warning**—A tornado has been sighted or indicated by weather radar. Take shelter immediately.

Once a warning has been issued, residents may have only a matter of seconds or minutes to seek shelter.

15.3 SECONDARY HAZARDS

Tornadoes may cause loss of power if utility service is disrupted. Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure is damaged that houses such materials or if such a material is in transport.

15.4 CLIMATE CHANGE IMPACTS

Climate change impacts on the frequency and severity of tornadoes are unclear. According to the Center for Climate Change and Energy Solutions, "Researchers are working to better understand how the building blocks for tornadoes—atmospheric instability and wind shear—will respond to global warming. It is likely that a warmer, moister world would allow for more frequent instability. However, it is also likely that a warmer world would lessen chances for wind shear. Recent trends for these quantities in the Midwest during the spring are inconclusive. It is also possible that these changes could shift the timing of tornadoes or regions that are most likely to be hit" (Center for Climate and Energy Solutions No date).

15.5 EXPOSURE

15.5.1 Population

It can be assumed that the entire planning area is exposed to some extent to tornadoes. Certain areas are more exposed due to geographic location and local weather patterns.

15.5.2 Property

According to the Las Animas County Assessor, there are 14,232 buildings in the planning area. Most of these buildings are residential. Property located at lower elevations are more likely to be exposed to tornadoes.

15.5.3 Critical Facilities and Infrastructure

All critical facilities and infrastructure (see Table 5-4 and Table 5-5) are likely exposed to tornadoes. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

15.5.4 Environment

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado.

15.6 VULNERABILITY

15.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard.

Individuals caught in the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or who do not have access to basements, cellars, or safe rooms.

15.6.2 Property

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. There are a total of 14,232 buildings in Las Animas County, but it is unlikely many of these structures will be affected.

Tornadoes do occur in Las Animas County. Based on historic tornado data, an average of 0.47 tornadoes occur each year in Las Animas County. The average loss expectancy for each event is $10,278 and the annualized loss is only $468 over the 62-year timeframe.

15.6.3 Critical Facilities and Infrastructure

Tornadoes can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Any facility that is in the path of a tornado is likely to sustain damage.

15.6.4 Environment

Environmental vulnerability will typically be the same as exposure (discussed in Section 15.5.4); however, if tornadoes impact facilities that store HAZMAT, areas impacted by material releases may be especially vulnerable.

15.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by tornadoes, particularly development that occurs at lower elevations. Development regulations that require safe rooms, basements, or other structures that reduce risk to people would decrease vulnerability. Tornadoes that cause a lot of damage are uncommon in the county, so mandatory regulations may not be cost-effective.

15.8 SCENARIO

If an EF3 or higher tornado were to hit the City of Trinidad then substantial damage to property and loss of life could result. Likelihood of injuries and fatalities would increase if warning time was limited before the event or if residents were unable to find adequate shelter. Damage to critical facilities and infrastructure would likely include loss of power, water, sewer, gas and communications. Roads and bridges could be blocked by debris or otherwise damaged. The most serious damage would be seen in the direct path of the tornado, but secondary effects could impact the rest of the county through loss of government services and interruptions in the transportation network. Debris from the tornado would need to be collected and properly disposed. Such an event would likely have substantial negative effects on the local economy.

15.9 ISSUES

Important issues associated with a tornado in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to tornadoes.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Roads and bridges blocked by debris or otherwise damaged might isolate populations.
- Warning time may not be adequate for residents to seek appropriate shelter or such shelter may not be widespread throughout the planning area.
- The impacts of climate change on the frequency and severity of tornadoes are not well understood.

CHAPTER 16.
WILDFIRE

WILDFIRE HAZARD RANKING	
Las Animas County	High
City of Trinidad	High
Town of Aguilar	Low
Town of Cokedale	High
Stonewall Fire Protection District	High
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Conflagration—A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup, and explosions are usually the elements behind a wildfire conflagration.

Interface Area—An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

16.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as wildland urban interface (WUI) areas, where development is adjacent to densely vegetated areas.

Wildfires are of significant concern throughout Colorado. According to the Colorado State Forest Service, vegetation fires occur on an annual basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and become wildfires, damage can be extensive. According to the 2013 *State of Colorado Natural Hazards Mitigation Plan*, a century of aggressive fire suppression combined with cycles of drought and changing land management practices has left many of Colorado's forests, including those in Las Animas County, unnaturally dense and ready to burn. Further, the threat of wildfire and potential losses is constantly increasing as human development and population increases and the WUI expands. Another contributing factor to fuel loads in the forest are standing trees killed by pine bark beetles, which have been affecting the forests of Colorado since 2002, becoming more widespread and a serious concern. According to the Las Animas County Hazard Mitigation Community Survey conducted in 2015 (see Appendix C), Las Animas County residents believe that wildfire is the one of their greatest threat to their safety.

Fire Protection in Las Animas County

Fire protection in Las Animas County is provided by nine fire protection districts as seen in Figure 5-18. Multiple community wildfire protection plans are in place, as discussed in Section 5.9.3.

Vegetation Classes in Las Animas County

General vegetation for Las Animas County is described in Table 16-1. The most common vegetation classes in the county are Aspen and Pinyon-Juniper, comprising over 80.7% of the acreage in the county.

**TABLE 16-1.
VEGETATION CLASSES IN LAS ANIMAS COUNTY**

Class	Acres	Percent (%)
Grassland	43,914	1.5
Shrubland	62,921	2.1
Aspen	2,007,716	66.6
Lodgepole Pine	5,790	0.2
Ponderosa Pine	135	0.0
Spruce-Fir	117,077	3.9
Mixed Conifer	18,516	0.6
Oak Shrubland	1,729	0.1
Pinyon-Juniper	424,581	14.1
Riparian	184,273	6.1
Introduced Riparian	26,126	0.9
Agriculture	105,933	3.5
Open Water	16,909	0.6
Urban and Community	728	0.0
Total	**3,016,349**	**100.0**

Source: Las Animas County Wildfire Risk Summary Report

16.2 HAZARD PROFILE

16.2.1 Past Events

According to the *Wildfire in Colorado: Preliminary Report on the 2012 Wildfire Season*, the *2006 Santa Fe Trail Ranch CWPP*, the *2008 Spirit Mountain Ranch CWPP*, and the *2014 Stonewall FPD CWPP*, the following wildfire (over 10 acres in size) events have been recorded in Las Animas County since 1993:

2002 Crazy French Fire—Burned 300 acres

June 2-14, 2002 Trinidad Complex Fire— Burned 33,000 acres. It was caused by lightning.

2002 James John Fire—Burned 6,800 acres

January 2006 Mauricio Canyon Fire—Burned 4,500 acres and destroyed 5 homes. This wind-driven fire made a five mile run in two hours during extremely windy conditions.

June 8 – July 9, 2008 Bridger Fire—Burned 45,800 acres at the Pinon Canyon Maneuver Site and 3 structures were lost. Lightning caused the fire.

May 15-17, 2011 Furnish Fire—Burned 8,000 acres and was caused by lightning.

June 5-21, 2011 Bear Springs/Callie Marie Fires—Burned 44,662 acres at the Pinon Canyon Maneuver Site and 5 structures were lost. Lightning caused the fire.

June 7-17, 2011 Shell Complex Fire—Burned 13,312 acres in Las Animas County 15 miles north of the Town of Kim and 7 structures were lost. Lightning caused the fire.

June 12-18, 2011 Track Fire—Burned 27,792 acres and destroyed 11 structures along the New Mexico/Colorado border. It was human caused.

2013 East Peak Fire—Burned 13,572 acres and it was caused by lightning.

Source: Las Animas County Emergency Management

Figure 16-1. Photo of June 2011 Shell Complex Fire

Source: Las Animas County Emergency Management

Figure 16-2. Photo After June 2011 Track Fire. Photo taken July 2011.

16.2.2 Location

Colorado overall is one of the fastest growing states in the nation. Much of this growth is occurring in the WUI area, where structures and other human improvements meet and mix with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk from wildfires. Figure 16-3 shows the Las Animas County housing density within the WUI.

The Colorado State Forest Service's Colorado Wildfire Risk Assessment Portal (CO-WRAP)report for Las Animas County maps the WUI Risk Index, which is a rating of the potential impact of a wildfire on people and their homes. The key input reflects housing density (Figure 16-3). The CO-WRAP report states that the location of people living in the WUI and rural areas is essential for defining potential wildfire impacts to people and homes. Figure 16-4 shows the WUI Risk Index for Las Animas County.

Wildfire risk represents the possibility of loss or harm occurring from a wildfire. Risk is derived by combining the wildfire threat and the fire effects assessment outputs. It identifies areas with the greatest potential impacts from a wildfire. Wildfire risk combines the likelihood of a fire occurring (threat) with those areas of most concern that are adversely impacted by fire to derive a single overall measure of wildfire risk. Figure 16-5 shows the wildfire risks for areas within Las Animas County.

Finally, as stated in the CO-WRAP report, wildfire threat is the likelihood of an acre burning. Threat is calculated by combining multiple landscape characteristics including surface and canopy fuels, fire behavior, historical fire occurrences, weather observations, terrain conditions, etc. The measure of wildfire threat used in CO-WRAP is called the threat index. Figure 16-6 maps the threat index for Las Animas County as identified in the CO-WRAP report.

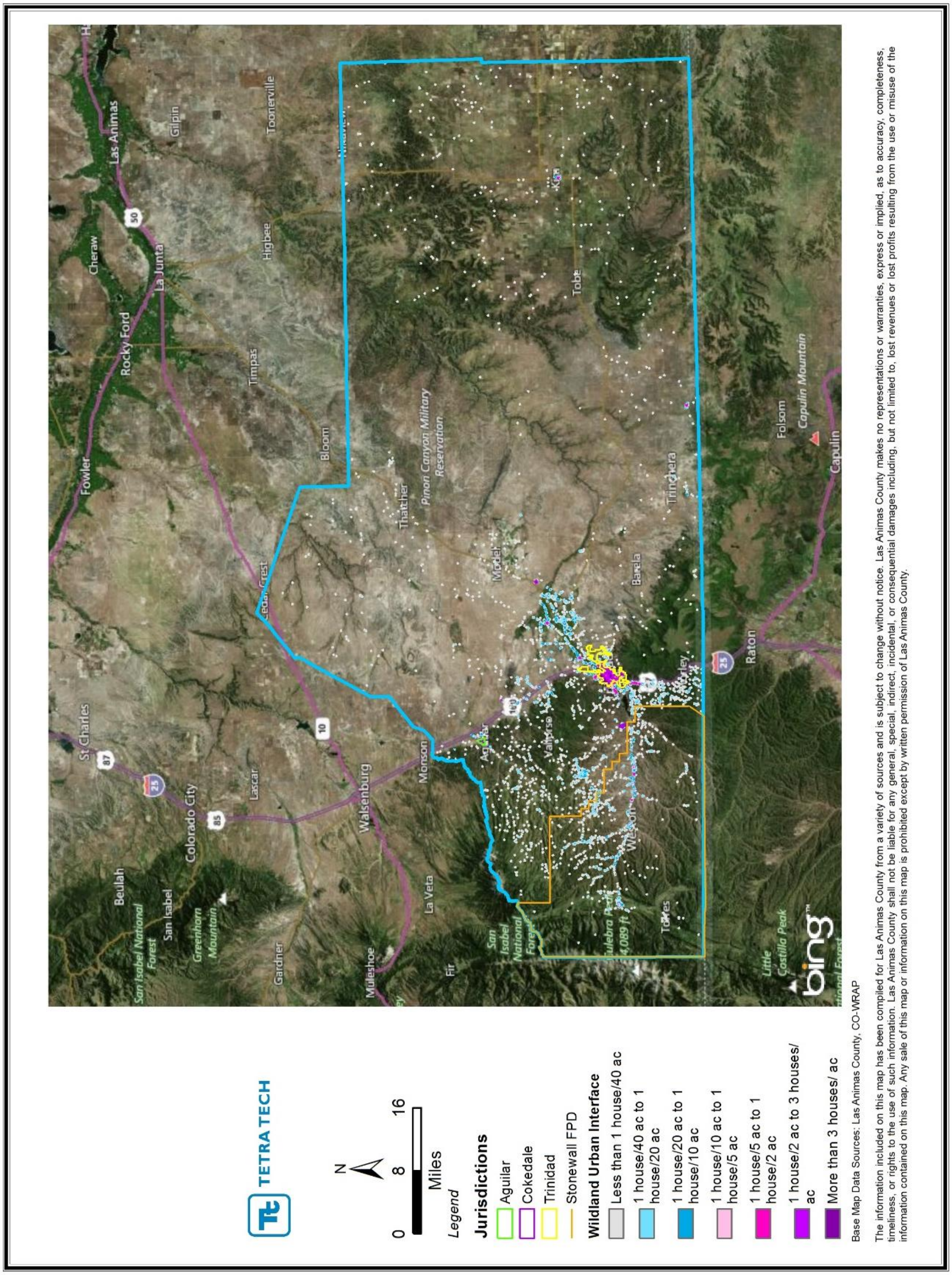


Figure 16-3. Las Animas County Housing Density Within the Wildland Urban Interface

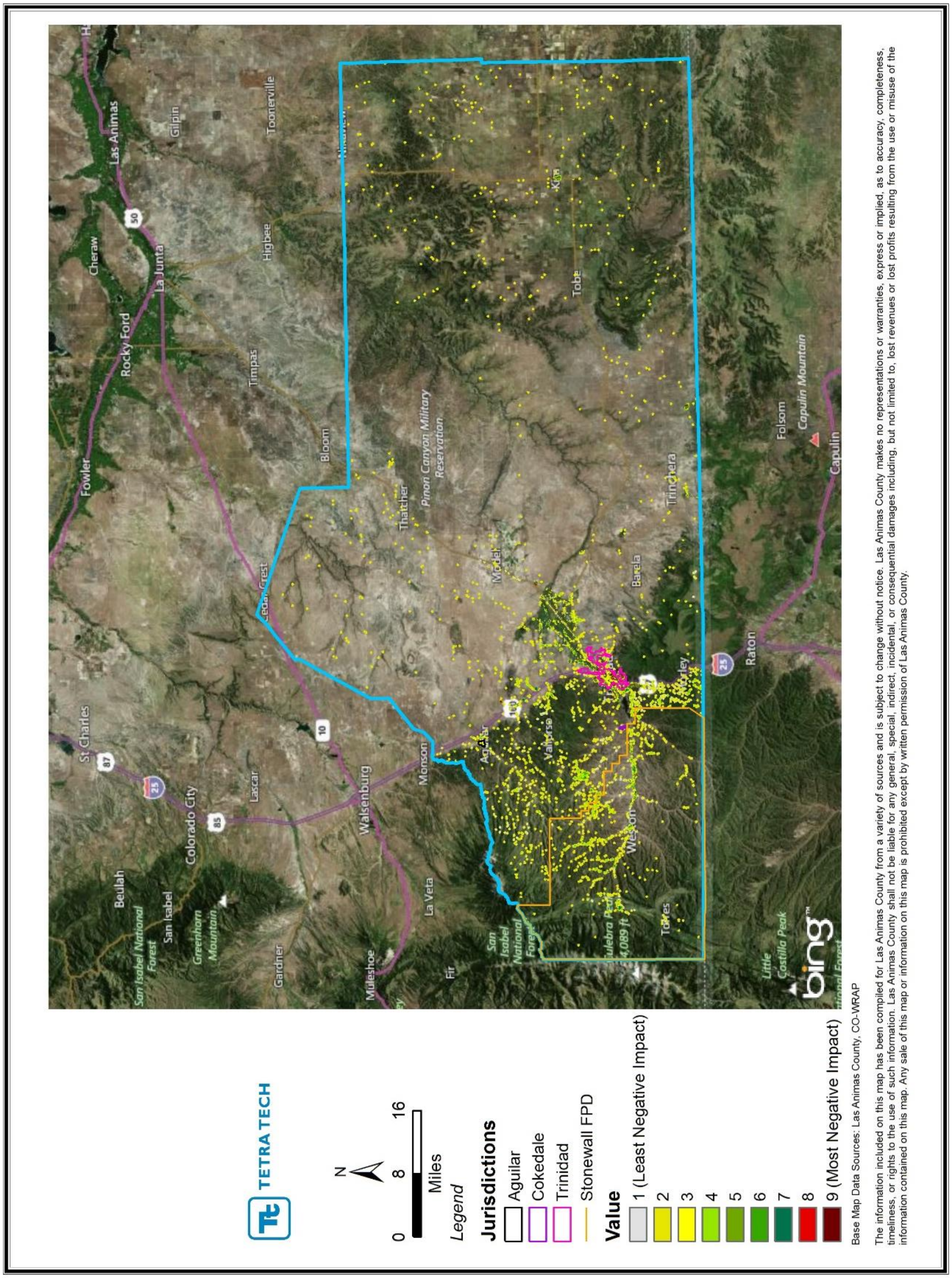


Figure 16-4. Wildland Urban Interface Risk Index for Las Animas County

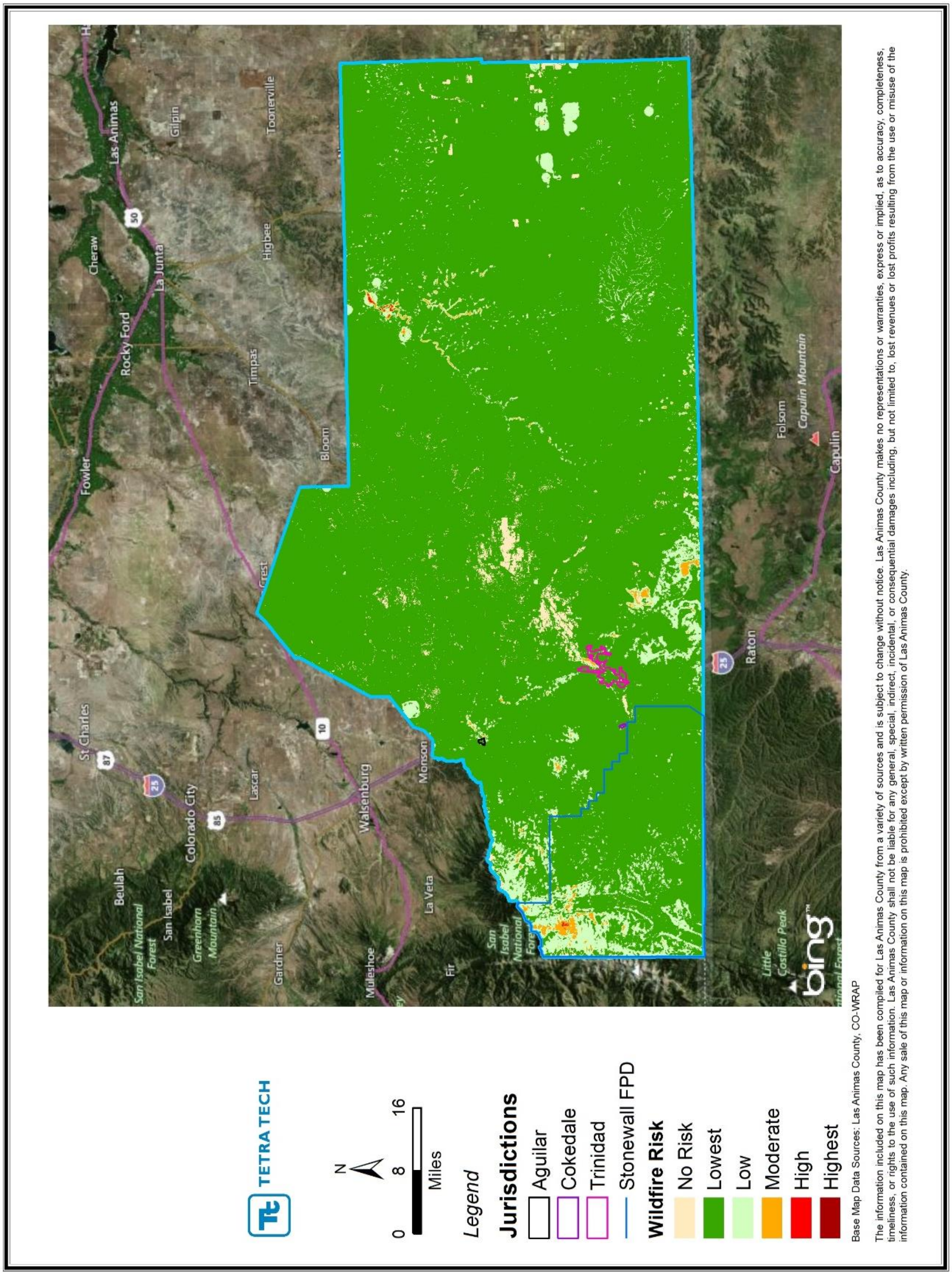


Figure 16-5. Wildfire Risks for Areas in Las Animas County

16.2.3 Frequency and Severity

According to the *Colorado State Wildfire Risk Assessment Report for Las Animas County*, there is a strong probability that at least one wildfire will occur each year in Las Animas County.

Based on the information in this hazard profile and the widespread impacts, the magnitude/severity of severe wildfires is considered moderate, unlikely to cause isolated deaths and multiple injuries, but could have major or long-term property damage that threatens structural stability; or interruption of essential facilities and services for 24 to 72 hours—as well as moderate duration economic impact due to interrupted tourism, which plays a major part in the economy of Las Animas County. Overall significance of the hazard is considered moderate.

The Steering Committee members rated the wildfire hazard as high for Las Animas County, the City of Trinidad, the Town of Cokedale, and the SFPD, but the Town of Aguilar rated it as a moderate hazard overall.

16.2.4 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Because fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable NWS lightning warnings are available on average 24 to 48 hours before a significant electrical storm.

If a fire does break out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid expansion of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

16.3 SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

16.4 CLIMATE CHANGE IMPACTS

Fire in western ecosystems is affected by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic Oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region.

Climate scenarios project summer temperature increases between 2 degrees Celsius (ºC) and 5°C and precipitation decreases of up to 15%. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

16.5 EXPOSURE

Information for the exposure analyses provided in the sections below was downloaded from the CO-WRAP Wildfire Threat theme from the CO-WRAP website in July 2016. The distribution of threat areas in the planning area are shown in Figure 16-6 and Figure 16-7. The county incorporated CO-WRAP data to provide a more accurate wildfire threat analysis. Threat exposure was used because it is the likelihood of an acre burning. It is derived by combing a number of landscape characteristics including surface fuels and canopy fuels, resultant fire behavior, historical fire occurrence, percentile weather derived from historical weather observations, and terrain conditions.

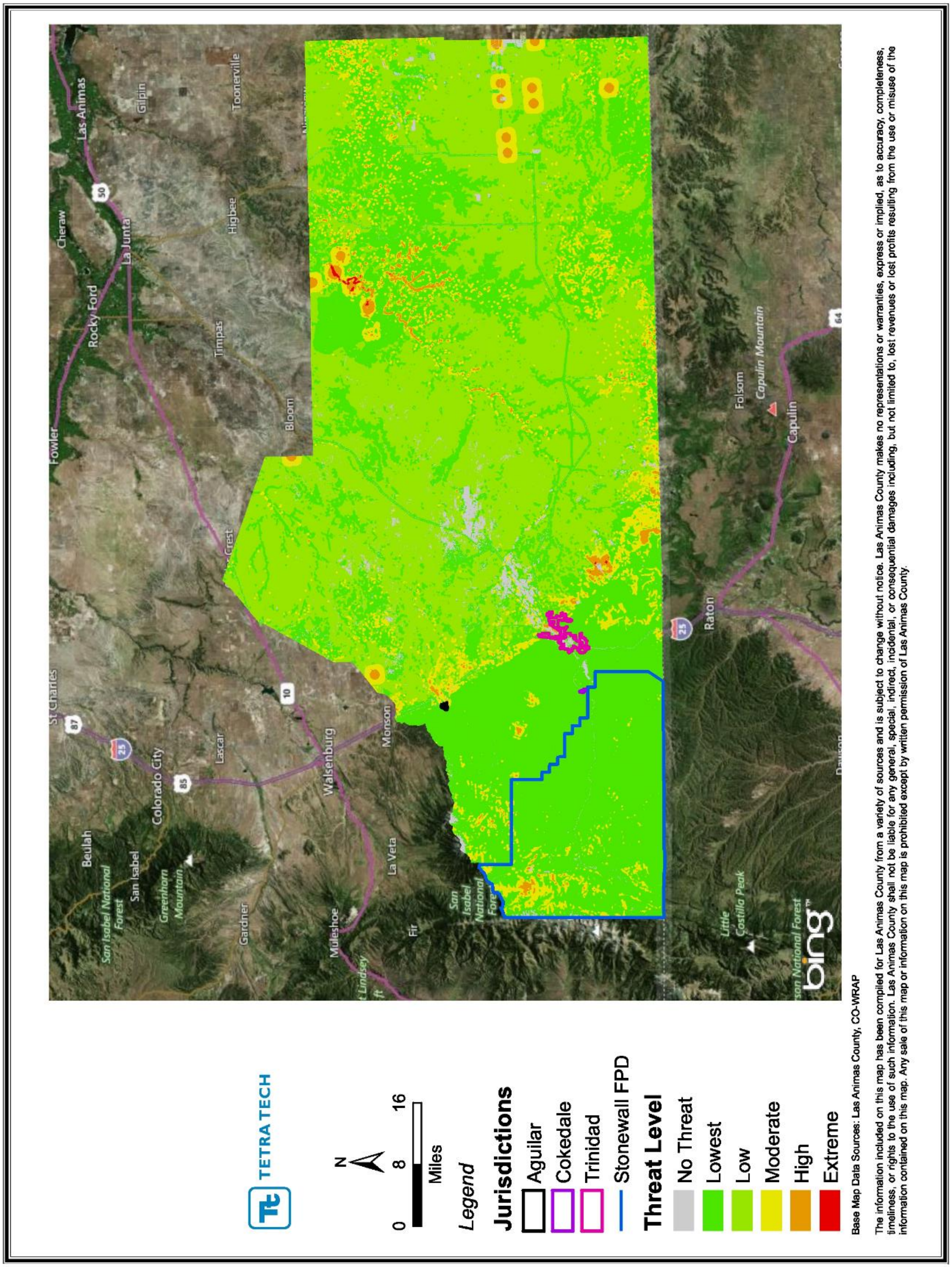


Figure 16-6. Wildfire Threat Index in Las Animas County

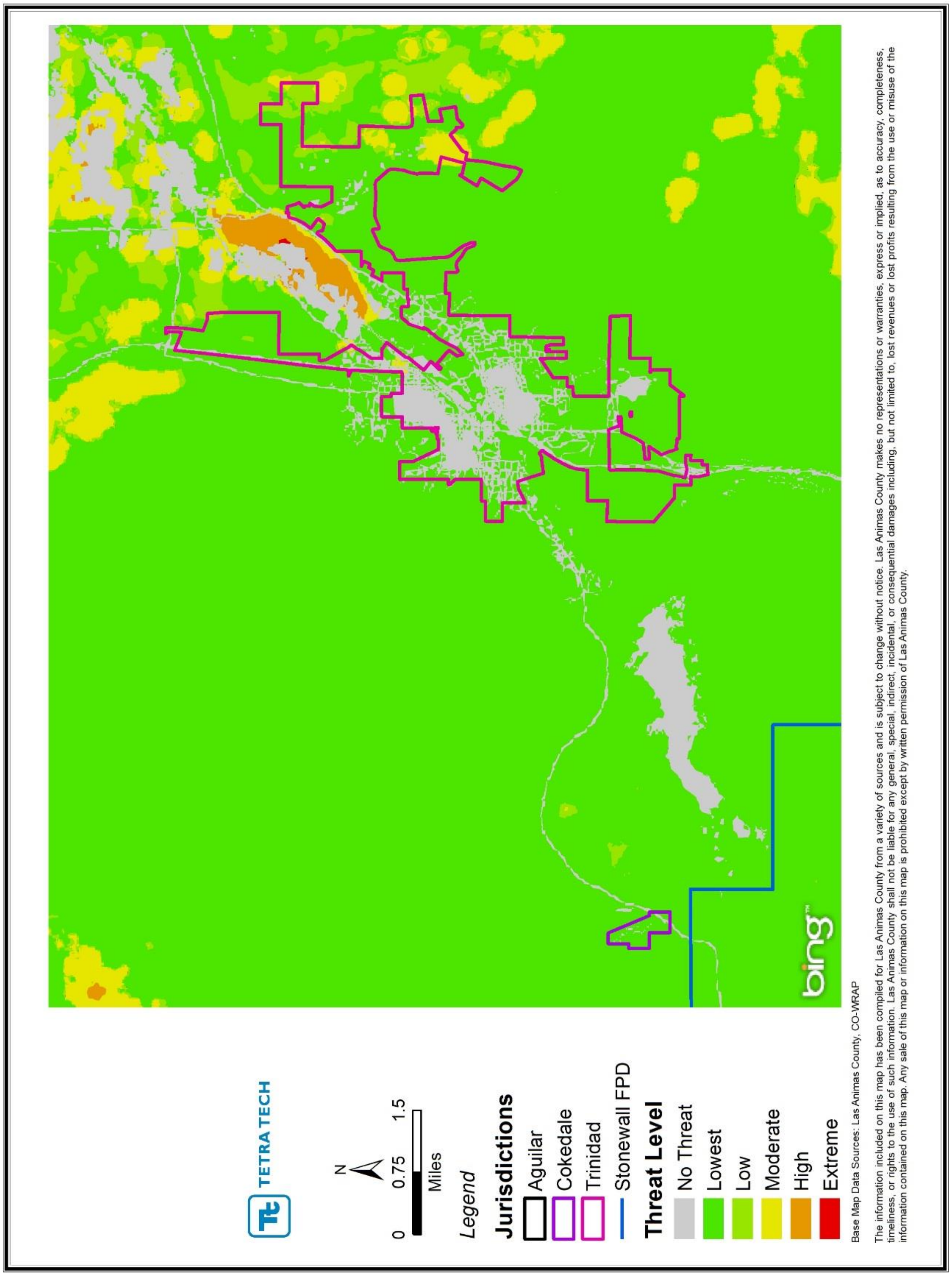


Figure 16-7. Wildfire Threat in the City of Trinidad and the Town of Cokedale

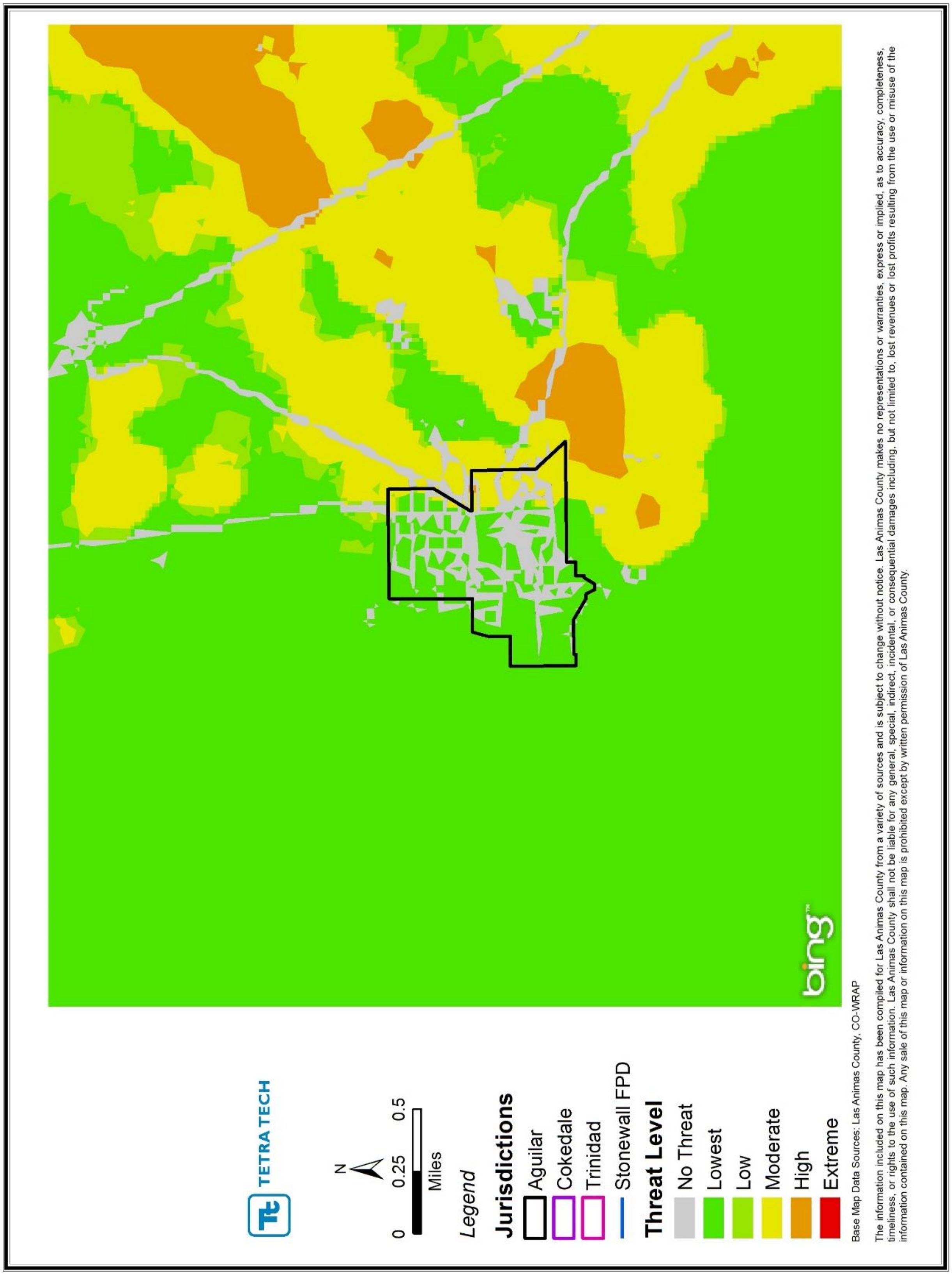


Figure 16-8. Wildfire Threat in the Town of Aguilar

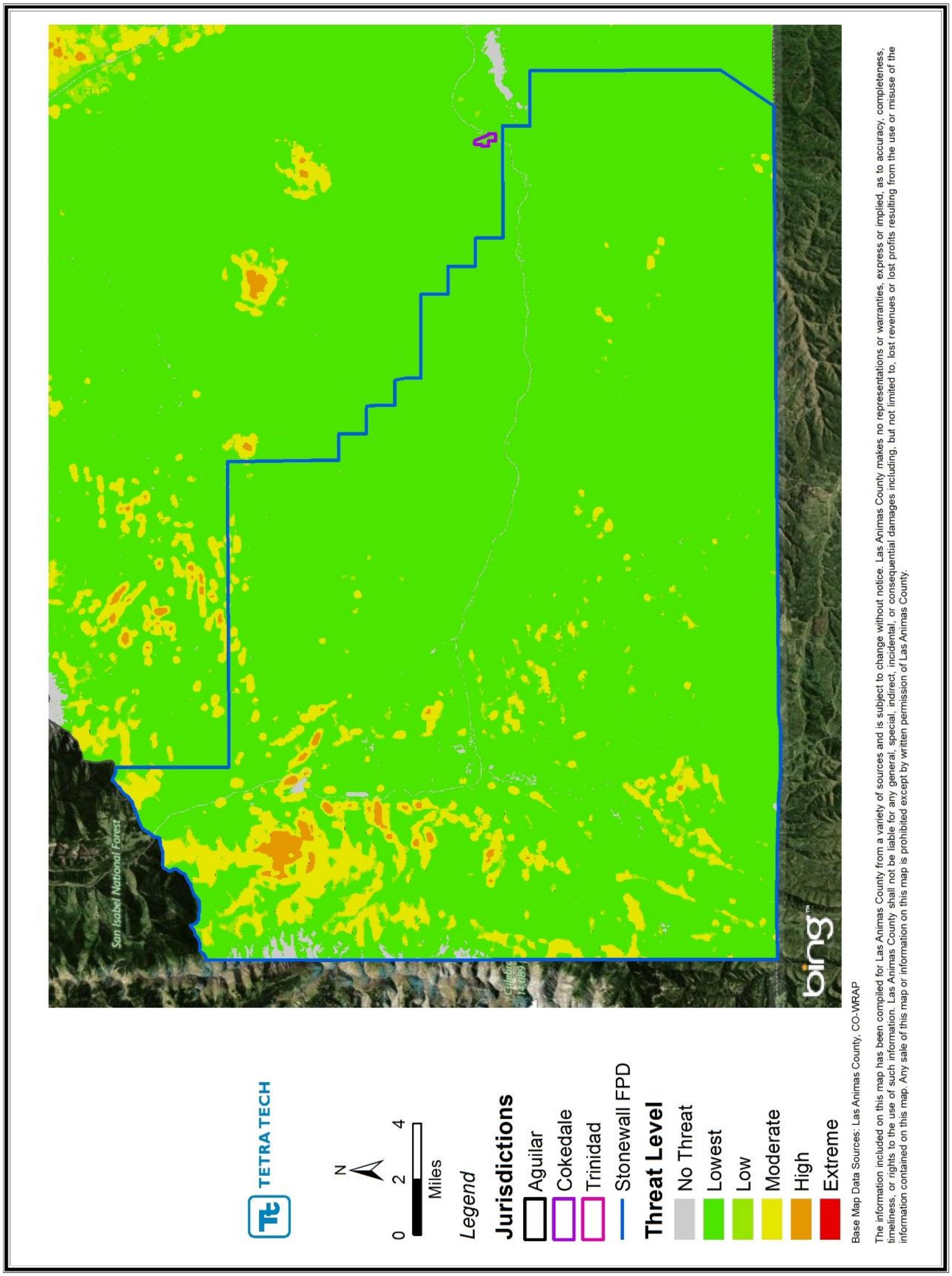


Figure 16-9. Wildfire Threat in the Stonewall Fire Protection District

16.5.1 Population

Population could not be examined by WUI area because parcel and tax assessor information was in the process of being updated and incomplete. However, population exposure was estimated using the percentage of WUI threat area in each census block for Las Animas County. These population estimates were adjusted to reflect the change in population from 2010 U.S. Census data according to 2016 Colorado State Demography projections. These estimates are shown in Table 16-2.

TABLE 16-2.
POPULATION WITHIN WILDFIRE THREAT AREAS

	Lowest and Low Threat		Moderate Threat		High and Extreme Threat	
	Population	% of Total	Population	% of Total	Population	% of Total
Aguilar	255	2.7	24	7.0	0	0.0
Cokedale	110	1.2	0	0.0	0	0.0
Stonewall FPD	1,114	11.8	10	3.1	0	0.0
Trinidad	4,244	44.9	3	0.9	0	0.0
Unincorporated County	3,340	35.3	280	83.3	35	100.0
Total	**9,063**	**100.0**	**317**	**100.0**	**35**	**100.0**

16.5.2 Property

Property damage from wildfires can be severe and can significantly alter entire communities. Table 16-3 through Table 16-5 display the number of structures in the various wildfire hazard zones within the planning area and their values. For all tables, exposure numbers are based on Las Animas County census block data.

TABLE 16-3.
EXPOSURE AND VALUE OF STRUCTURES IN EXTREME AND HIGH WILDFIRE THREAT AREAS

	Buildings Exposed	Value Exposed Structure and Content	Acres
Aguilar	0	$0	< 1
Cokedale	0	$0	0
Stonewall FPD	1	$190,000	1984
Trinidad	0	$0	< 1
Unincorporated County	23	$6,442,000	40,031
Total	**24**	**$6,632,000**	**42,015**

TABLE 16-4.
EXPOSURE AND VALUE OF STRUCTURES IN MODERATE WILDFIRE THREAT AREAS

Jurisdiction	Buildings Exposed	Value Exposed Structure and Content	Acres
Aguilar	15	$3,564,000	30
Cokedale	0	$0	0
Stonewall FPD	17	$5,819,000	22,703
Trinidad	5	$4,201,000	149
Unincorporated County	187	$48,543,000	226,532
Total	**224**	**$62,127,000**	**249,414**

TABLE 16-5.
EXPOSURE AND VALUE OF STRUCTURES IN LOWEST AND LOW WILDFIRE THREAT AREAS

	Buildings Exposed	Value Exposed Structure and Content	Acres
Aguilar	151	$35,204,000	132
Cokedale	87	$27,081,000	122
Stonewall FPD	954	$322,495,000	321,295
Trinidad	1,341	$517,950,000	4,343
Unincorporated County	2,089	$588,536,000	2,385,143
Total	**4,622**	**$1,491,266,000**	**2,711,035**

Present Land Use

Present land use for each wildfire threat area is described in Table 16-6 and Table 16-7.

TABLE 16-6.
PRESENT LAND USE IN EXTREME AND HIGH WILDFIRE THREAT AREAS

	Extreme		High	
Present Use Classification	Area (acres)	% of Total	Area (acres)	% of Total
Agriculture	2	0.2	36	0.1
Barren Land	0	0.0	2	<0.1
Developed, High Intensity	0	0.0	0	0.0
Developed, Medium Intensity	0	0.0	0	0.0
Developed, Low Intensity	0	0.0	6	<0.1

**TABLE 16-6.
PRESENT LAND USE IN EXTREME AND HIGH WILDFIRE THREAT AREAS**

	Extreme		High	
Present Use Classification	Area (acres)	% of Total	Area (acres)	% of Total
Developed, Open Space	0	0.0	227	0.6
Forest	16	1.1	4,801	11.8
Grassland/Prairie	431	29.4	17,293	42.7
Shrub/Scrub	655	44.7	17,177	42.4
Water/Wetlands	363	24.7	1,000	2.5
Total	**1,467**	**100.0**	**40,541**	**100.0**

**TABLE 16-7.
PRESENT LAND USE IN MODERATE, LOW AND LOWEST WILDFIRE THREAT AREAS**

	Moderate		Low		Lowest	
Present Use Classification	Area (acres)	% of Total	Area (acres)	% of Total	Area (acres)	% of Total
Agriculture	207	0.1	280	<0.1	1,453	0.1
Barren Land	13	<0.1	121	<0.1	341	0.0
Developed, High Intensity	0	0.0	0	0.0	24	<0.1
Developed, Medium Intensity	1	<0.1	4	<0.1	113	<0.1
Developed, Low Intensity	43	<0.1	11	<0.1	1,211	0.1
Developed, Open Space	518	0.2	189	<0.1	7,088	0.5
Forest	57,735	23.2	18,603	1.3	484,766	36.9
Grassland/Prairie	107,158	43.0	1,312,914	93.9	407,692	31.0
Shrub/Scrub	81,824	32.8	63,505	4.5	395,639	30.1
Water/Wetlands	1,896	0.8	2,241	0.2	14,699	1.1
Total	**249,394**	**100.0**	**1,397,868**	**100.0**	**1,313,024**	**100.0**

16.5.3 Critical Facilities and Infrastructure

Table 16-8 identifies critical facilities exposed to the wildfire hazard in the county.

TABLE 16-8.
CRITICAL FACILITIES AND INFRASTRUCTURE IN WILDFIRE THREAT AREAS

	Number of Critical Facilities in Hazard Zone				
	Lowest Threat	Low Threat	Moderate Threat	High Threat	Extreme Threat
Medical and Health	1	0	0	0	0
Protective Functions	9	1	0	0	0
Schools	6	2	0	0	0
Bridges	120	30	23	4	0
Potable Water	10	0	0	0	0
Wastewater	2	0	0	0	0
Power	2	0	0	0	0
Communications	1	0	0	0	0
Natural Gas	5	0	0	0	0
Transportation	2	0	0	0	0
Dams	31	5	3	0	0
Other Essential	6	1	0	0	0
Total	**195**	**39**	**26**	**4**	**0**

In the event of wildfire, there would likely be little damage to the majority of infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk to wildfire because most power poles are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion. Several critical facilities and infrastructure are located in the non-burnable threat area. This is primarily in areas of urban centers, such as downtown Trinidad and includes several schools, protective functions, and bridges.

16.5.4 Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.

- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- Destroyed Endangered Species Habitat—Catastrophic fires can have devastating consequences for endangered species.

- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called “fire regimes,” include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

16.6 VULNERABILITY

Structures, aboveground infrastructure, critical facilities, and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure, and environment are assumed to be the same as described in the section on exposure.

16.6.1 Population

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

16.6.2 Property

Loss estimations for the wildfire hazard are not based on damage functions, because no such damage functions have been generated. Instead, damage estimates have been made by intersecting the CO-WRAP data with 2015 county tax assessor data. Table 16-3 through Table 16-5 summarizes the estimated exposed value in each wildfire threat category.

16.6.3 Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

16.7 FUTURE TRENDS IN DEVELOPMENT

There are three CWPPs in Las Animas County to assist the county with wildfire preparation and provide effective techniques to combat wildfires while protecting property and persons.

The expansion of the WUI can be managed with strong land use and building codes.

16.8 SCENARIO

A major conflagration in the planning area might begin with a wet spring, adding to fuels already present on the forest floor. Flash fuels would build throughout the spring. The summer could see the onset of insect infestation. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lightning storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers would be deep in the forests and interface zones. Fires that start in flat areas move slower, but wind still pushes them. It is not unusual for a wildfire pushed by wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving more remote subdivisions.

The worst-case scenario would include an active fire season throughout the American West, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into the Purgatoire River, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

16.9 ISSUES

The major issues for wildfire are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change could affect the wildfire hazard.
- Future growth into interface areas should continue to be managed.
- Area fire districts need to continue to train on WUI events.
- Vegetation management activities should be enhanced.
- Both the natural and human-caused conditions that contribute to the wildland fire hazard are tending to exacerbate through time.
- Conservative forestry management practices have resulted in congested forests prone to fire and disease.
- The continued migration of inhabitants to remote areas of the county increases the probability of human-caused ignitions from vehicles, grills, campfires, and electrical devices.

- Non-native species have become invasive in the area, specifically, tamarisk and Russian olive. These species burn readily and pose a threat to homes and other structures in the lower reaches of the county and into municipalities.
- Revisions to the Colorado Revised Statutes exempted properties divided into parcels of 35 acres or more from the statutory definition of a subdivision restricting the county’s ability to enforce county regulations and mitigation.

CHAPTER 17. WINTER STORM

WINTER STORM HAZARD RANKING	
Las Animas County	High
City of Trinidad	High
Town of Aguilar	High
Town of Cokedale	High
Stonewall Fire Protection District	Low
See Chapter 18 for more information on hazard ranking.	

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to 6 tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Winter Storm—A storm having significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

17.1 GENERAL BACKGROUND

Winter storms can include heavy snow, ice, and blizzard conditions. Heavy snow can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns.

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until damage can be repaired. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibilities to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents can result in injuries and deaths.

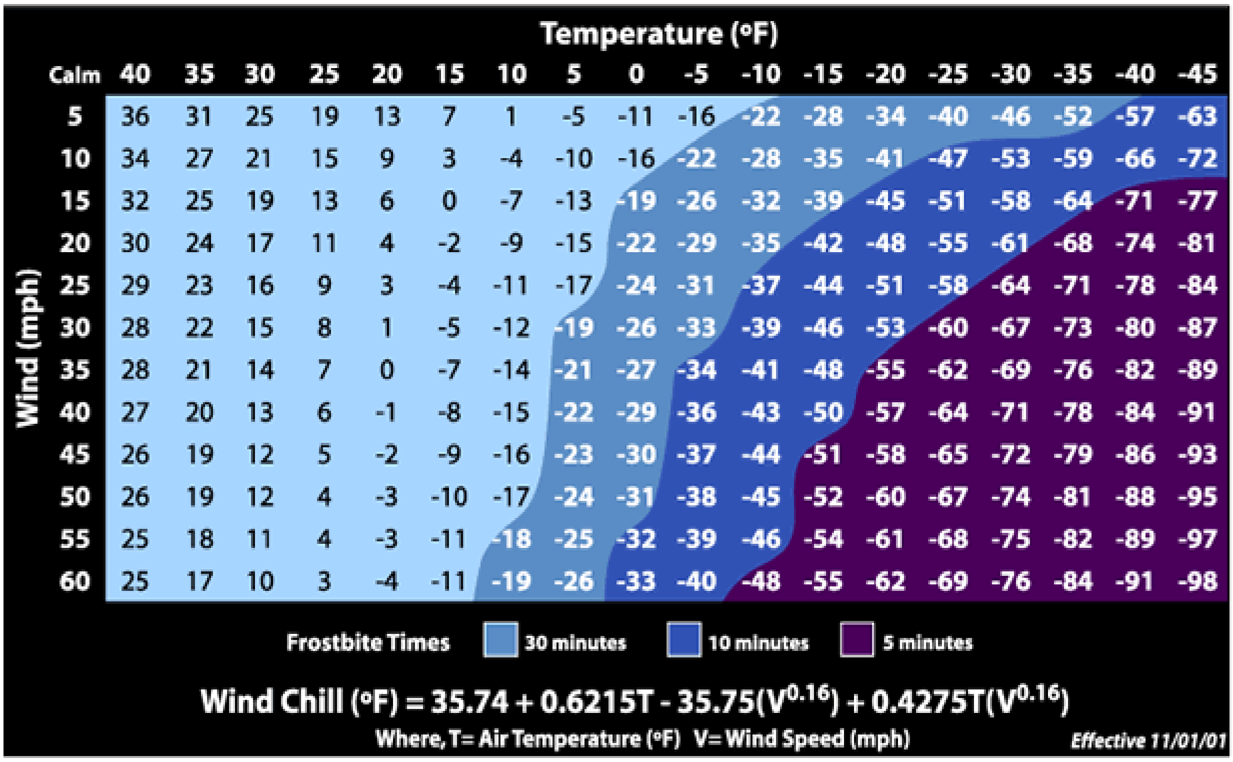
Winter storms in Las Animas County, including strong winds and blizzard conditions, can result in property damage, localized power and phone outages and closures of streets, highways, schools, businesses, and non-essential government operations. People can also become isolated from essential services in their homes and vehicles. A winter storm can escalate, creating life threatening situations when emergency response is limited by severe winter conditions. Other issues associated with severe winter weather include hypothermia and the threat of physical overexertion that may lead to heart attacks or strokes. Snow removal costs can also impact budgets significantly. Heavy snowfall during winter can also lead to flooding or landslides during the spring if the area snowpack melts too quickly.

17.1.1 Extreme Cold

Extreme cold often accompanies a winter storm or is left in its wake. It is most likely to occur in the winter months of December, January, and February. Prolonged exposure to the cold can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Extreme cold can disrupt or impair communications facilities.

In 2001, the NWS implemented an updated wind chill temperature index (see Figure 17-1). This index describes the relative discomfort or danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Source: National Weather Service, www.nws.noaa.gov/om/windchill/index.shtml



Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 17-1. National Weather Service Wind Chill Chart

A wind chill watch is issued by the NWS when wind chill warning criteria are possible in the next 12 to 36 hours. A wind chill warning is issued for wind chills of at least -25°F on the plains and -35°F in the mountains and foothills.

The Western Regional Climate Center reports data summaries from a station in the City of Trinidad. Table 17-1 contains temperature summaries related to extreme cold recorded by the station from 1898 through 2012.

TABLE 17-1.
TEMPERATURE DATA FROM TRINIDAD (1898-2012)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (degrees Fahrenheit)												
Average Maximum Temperature	48.5	51.1	56.9	64.9	73.5	83.1	86.8	84.7	79.1	69.3	56.8	49.0
Average Minimum Temperature	18.9	21.6	27.3	34.8	43.7	52.5	57.3	55.9	48.8	37.8	27.0	20.1
Average Temperature	33.7	36.3	42.1	49.9	58.6	67.8	72.1	70.3	63.9	53.6	41.9	34.5
Extreme Temperatures (degrees Fahrenheit)												
Extreme Minimum Temperature	-32	-21	-15	-6	22	29	42	37	23	-3	-15	-26
Average Number of Days												
Minimum Temperature below 32 degrees Fahrenheit	28.7	25.2	22.2	11.6	2.2	0.0	0.0	0.0	0.6	7.4	22.4	28.3
Minimum Temperature below 0 degrees Fahrenheit	1.7	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2

17.1.2 Snowfall

Las Animas County receives varying amounts of snow throughout the area. The City of Trinidad and the Town of Aguilar experience similar winter weather and snowfall. They experience an annual average snowfall of approximately 50 inches, while the Town of Cokedale experiences approximately 30 inches. Table 17-2 lists the average snow depth in Trinidad is one inch between November and April. February and March are typically the months with the most snow in the county.

TABLE 17-2.
SNOWFALL DATA FROM TRINIDAD (1898-2012)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Snowfall (inches)												
Average Total Snowfall	6.5	8.6	9.6	6.6	1.2	0.0	0.0	0.0	0.2	2.3	6.7	9.0
Snow Depth (inches)												
Average Snow Depth	1	1	1	1	0	0	0	0	0	0	1	1

17.2 HAZARD PROFILE

17.2.1 Past Events

A total of 312 winter weather events occurred in Las Animas County between 1996 and 2015. The event types include a combination of "Blizzard," "Heavy Snow," "Winter Weather," and "Winter Storm." Locations for the records are limited to one of six National Climate Data Center's-defined zones. Table 17-3 shows the distribution of weather events throughout the county.

TABLE 17-3.
LAS ANIMAS COUNTY WINTER WEATHER EVENTS (1996-2015)

Location	Event Type	Number of Events
Eastern Las Animas County	Blizzard	7
	Heavy Snow	1
	Winter Storm	11
Southern Sangre de Cristo Mountains Above 11,000 feet	Blizzard	1
	Heavy Snow	13
	Winter Storm	63
	Winter Weather	5
Southern Sangre de Cristo Mountains Between 7,500 and 11,000 feet	Blizzard	2
	Heavy Snow	28
	Winter Storm	58
	Winter Weather	8
Trinidad Vicinity/Lower Huerfano River Basin and Western Las Animas County Below 7,500 feet	Blizzard	4
	Heavy Snow	7
	Winter Storm	32
	Winter Weather	5
Upper Huerfano River Basin/Walsenburg And Vicinity	Blizzard	1
	Heavy Snow	22
	Winter Storm	17
	Winter Weather	0
Upper Purgatoire River Basin/Trinidad And Vicinity	Blizzard	1
	Heavy Snow	12
	Winter Storm	14
	Winter Weather	0

Source: National Centers for Environmental Information

Only two of the winter weather events resulted in property damage. The first event occurred on April 5, 2005, and resulted in $250,000 in damages. The second event occurred on October 24, 1997, and resulted in $300,000 in damages. Both events were categorized as blizzards.

Las Animas County was included in the following three FEMA Emergency Management Declarations for snow events.

- **FEMA-EM-3185-CO**: March 17, 2003 – The event was a large, slow moving, moist system that started on March 17th that brought persistent rain and snow to southern Colorado. Most of the accumulating snow fell above 6,000 feet, which included the central and southeast mountains and high valleys as well as the adjacent plains. Many areas around Trinidad in Las Animas County received over one foot of snow. In addition, sustained winds of 20 to 40 mph caused considerable blowing and drifting of snow, and blizzard conditions at times, closing several highways and portions of Interstate 25. Las Animas County was included in this emergency declaration for FEMA monies to cover snow removal and recover efforts.
- **FEMA-EM-3270-CO:** December 18, 2006 – Heavy snow and blizzard conditions occurred over the western mountains and eastern mountains as well as the southeast plains of southern Colorado. Some of the highest reported snow totals and snow drifts included 10 to 15 inches in the Kim area, and 4 foot snow drifts in Trinidad. Las Animas County was included in this emergency declaration for FEMA monies to cover snow removal and recover efforts.
- **FEMA-EM-3271-CO:** December 28, 2006 – Heavy snow and blizzard conditions impacted the western mountains and the eastern mountains as well as the southeast plains of southern Colorado. Wind gusts exceeded 55 mph. Snow amounts reached up to 48 inches, and snow drifts were noted as high as 18 feet. The following are the highest snow totals and snow drifts reported with this event: 36 inches in Trinidad, and 40 inches just northwest of Aguilar. It was estimated that at least 35,000 head of cattle perished throughout the region during and after the storm. Las Animas County was included in this emergency declaration for FEMA monies to cover snow removal and recovery efforts.

According to the USDA's Risk Management Agency, Las Animas County received $257,686 in payments for insured crop losses as a result of freeze, frost, and cold wet weather events that occurred between 2003 and 2015. The payments were made in the years of 2009, 2010, and 2013 for 7,956 acres that affected the grain, sorghum and wheat.

17.2.2 Location

The entire county is susceptible to severe winter storms; although severe winter weather is primarily found in the higher elevations of the county.

17.2.3 Frequency and Severity

Severe winter storms happen nearly every year in Las Animas County and are thus considered highly likely, with nearly 100% chance of occurrence in any given year. Severe winter weather occurs most frequently in December, January, and February.

The magnitude and severity of severe winter weather is considered moderate in Las Animas County. The annual rate of occurrence for the county is 16 events per year, however, the average loss expectancy is $1,763/event for all 312 events that have occurred in Las Animas County between 1996 and 2015. Therefore, the annualized loss for winter weather is $27,500.

The Steering Committee members rated winter storm as high in Las Animas County, the City of Trinidad, and the Towns of Aguilar and Cokedale. The Steering Committee members rated winter storm as low for the SFPD. All the Steering Committee members rated winter storm as a high probability of occurrence within the next 25 years.

17.2.4 Warning Time

Meteorologists can often predict the likelihood of a severe winter storm; and forecasts usually come from the City of Trinidad. When forecast are available they can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

17.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe winter storms are falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and constructed drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Additionally the storms may result in closed highways and blocked roads. It is not unusual for motorists and residents to become stranded. Annually, heavy snow loads and frozen pipes cause damage to residences and businesses. Late season heavy snows will typically cause some plant and crop damage.

17.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. Nationally, the number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 13-7). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

17.5 EXPOSURE

17.5.1 Population

It can be assumed that the entire planning area is exposed to some extent to severe winter weather events. Certain areas are more exposed due to geographic location and local weather patterns.

17.5.2 Property

According to the Las Animas County Assessor, there are 14,232 buildings within the census tracts that define the planning area. Most of these buildings are residential. All of these buildings are considered to be exposed to severe winter weather, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

17.5.3 Critical Facilities and Infrastructure

All critical facilities and infrastructure (see Table 5-4 and Table 5-5) are likely exposed to severe winter weather. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to ice or blowing snow. Ice accumulation on roadways can create dangerous driving conditions. There are limited county roads that are available to move people and supplies throughout the region.

17.5.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees risk major damage and destruction. Flooding events caused by snowmelt can produce river channel migration or damage riparian habitat.

17.6 VULNERABILITY

17.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe winter weather events and could suffer more secondary effects of the hazard. Commuters who are caught in storms may be particularly vulnerable. Stranded commuters may be vulnerable to carbon monoxide poisoning or hypothermia. Additionally, individuals engaged in outdoor recreation during a severe winter event may be difficult to locate and rescue.

17.6.2 Property

All property is vulnerable during severe winter weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

The annual rate of occurrence for a severe winter weather event in Las Animas County is approximately 16 winter weather events per year. The average loss expectancy for each winter weather event is $1,763, with an annualized loss of $27,500 for winter weather events in the county. This is based on the 312 total winter weather events that have occurred in the county between 1996 and 2015. Only two of the 312 reported events in Las Animas County resulted in property damage. These two blizzard events took place in the Upper Purgatoire River Basin/Trinidad and Vicinity on October 24, 1997, and Eastern Las Animas County Zone on April 5, 2005.

17.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from severe winter weather, mostly associated with secondary hazards. Snowstorms can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly. Prolonged obstruction of major routes can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

17.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure, discussed in Section 17.5.4.

17.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The vulnerability of community assets to severe winter storms is increasing through time as more people enter the planning area. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in general plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

17.8 SCENARIO

Although severe winter local storms are infrequent, impacts can be significant, particularly when secondary hazards of flood occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds, snow, ice, and downed trees. Some subdivisions could experience limited ingress and egress. Prolonged rain and snow melt could produce flooding, and overtopped culverts with ponded water on roads. Flooding and debris could further obstruct roads and bridges further isolating residents. Extreme cold temperatures would stress heating systems and expose residents to hypothermia.

17.9 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as heavy snow or windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- The high altitudes and rugged terrain in the planning area exacerbates emergency situations caused by winter storm events.
- Future efforts should be made to identify populations at risk and determine special needs during winter storm events.

CHAPTER 18.
PLANNING AREA RISK RANKING

A risk ranking was performed for the hazards of concern described in this plan. This risk ranking assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. The risk ranking was conducted by the Steering Committee based on the hazard risk assessment presented during the second Steering Committee meeting, community survey results, and personal and professional experience with hazards in the planning area. The results are used in establishing mitigation priorities.

18.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor = 2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor = 1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the area. The Steering Committee assigned the probabilities of occurrence for each hazard, as shown on Table 18-1.

TABLE 18-1.
HAZARD PROBABILITY OF OCCURRENCE

	Las Animas County		City of Trinidad		Town of Aguilar		Town of Cokedale		Stonewall FPD	
Hazard	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor
Avalanche	Low	1	Low	1	No	0	Low	1	Medium	2
Dam/Levee Failure	Medium	2	Medium	2	Low	1	Low	1	Low	1
Drought	High	3	High	3	Medium	2	High	3	Medium	2
Earthquake	High	3	High	3	Medium	2	High	3	High	3
Erosion and Deposition	Medium	2	Medium	2	Low	1	Low	1	Medium	2
Expansive Soils	Low	1	Medium	2	Low	1	Medium	2	Medium	2
Extreme Heat	Medium	2	High	3	Low	1	High	3	Low	1
Flood	Medium	2	High	3	Low	1	Low	1	Medium	2
Hail	High	3	High	3	Medium	2	High	3	Medium	2
Landslide, Mud/Debris Flow, Rockfall	Medium	2	Medium	2	Low	1	Low	1	Medium	2
Lightning	High	3	High	3	Low	1	High	3	Medium	2
Severe Wind	High	3	High	3	Medium	2	Medium	2	Medium	2
Subsidence	Low	1	Medium	2	Low	1	High	3	Low	1
Tornado	Medium	2	Medium	2	Low	1	Low	1	Low	1
Wildfire	High	3	High	3	Medium	2	High	3	High	3
Winter Storm	High	3	High	3	High	3	High	3	High	3

18.2 IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property, and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people who live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High – 50% or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium – 25% to 49% of the population is exposed to a hazard (Impact Factor = 2)
  - Low – 24% or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact – None of the population is exposed to a hazard (Impact Factor = 0)
- **Property**—Values were assigned based on the percentage of the total ***assessed property value*** exposed to the hazard event:
  - High – 30% or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium – 15% to 29% of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low – 14% or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact – None of the total assessed property value is exposed to a hazard (Impact Factor = 0)
- **Economy**—Values were assigned based on total impact to the economy from the hazard event and activities conducted after the even to restore the community to previous functions. Values were assigned based on the number of days the hazard impacts the community, including impacts on tourism, businesses, road closures, or government response agencies.
  - High – Community impacted for more than 7 days (Impact Factor = 3)
  - Medium – Community impacted for 1 to 7 days (Impact Factor = 2)
  - Low – Community impacted for less than 1 day (Impact Factor = 1)
  - No impact – No community impacts estimated from the hazard event (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1. The impacts for each hazard are summarized in Table 18-2 through Table 18-4. The total impact factor shown on the tables equals the impact factor multiplied by the weighting factor.

TABLE 18-2.
IMPACT ON PEOPLE FROM HAZARDS

	Las Animas County		City of Trinidad		Town of Aguilar		Town of Cokedale		Stonewall FPD	
Hazard	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor
Avalanche	Low	1	Low	1	No	0	Low	1	Low	1
Dam/Levee Failure	Medium	2	Medium	2	Low	1	Low	1	Low	1
Drought	High	3	High	3	High	3	High	3	Low	1
Earthquake	Medium	2	Medium	2	Medium	2	High	3	Medium	2
Erosion and Deposition	Low	1	Medium	2	Low	1	Low	1	Low	1
Expansive Soils	Low	1	Low	1	Low	1	Medium	2	Low	1
Extreme Heat	Medium	2	Medium	2	Low	1	High	3	Low	1
Flood	Medium	2	Medium	2	Low	1	Low	1	Low	1
Hail	High	3	Medium	2	Low	1	High	3	Medium	2
Landslide, Mud/Debris Flow, Rockfall	Low	1	Low	1	Low	1	Low	1	Low	1
Lightning	Medium	2	Medium	2	Low	1	High	3	Low	1
Severe Wind	Medium	2	Medium	2	Low	1	Medium	2	Low	1
Subsidence	Low	1	Medium	2	Low	1	High	3	Low	1
Tornado	Medium	2	Medium	2	Low	1	Low	1	Low	1
Wildfire	High	3	High	3	Low	1	High	3	High	3
Winter Storm	High	3	High	3	High	3	High	3	Low	1

**TABLE 18-3.
IMPACT ON PROPERTY FROM HAZARDS**

	Las Animas County		City of Trinidad		Town of Aguilar		Town of Cokedale		Stonewall FPD	
Hazard	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor
Avalanche	Low	1	Low	1	No	0	Low	1	Low	1
Dam/Levee Failure	Medium	2	High	3	Low	1	Low	1	Low	1
Drought	High	3	High	3	Medium	2	High	3	Low	1
Earthquake	Medium	2	High	3	Low	1	High	3	Medium	2
Erosion and Deposition	Low	1	Medium	2	Low	1	Low	1	Low	1
Expansive Soils	Low	1	Low	1	Low	1	Medium	2	Low	1
Extreme Heat	Medium	2	Medium	2	Low	1	High	3	Low	1
Flood	Medium	2	High	3	Low	1	Low	1	Low	1
Hail	High	3	Medium	2	High	3	High	3	Medium	2
Landslide, Mud/Debris Flow, Rockfall	Low	1	Low	1	Low	1	Low	1	Low	1
Lightning	Medium	2	Medium	2	Low	1	High	3	Low	1
Severe Wind	Medium	2	Medium	2	Low	1	Medium	2	Low	1
Subsidence	Low	1	Medium	2	Low	1	High	3	Low	1
Tornado	Medium	2	Medium	2	Medium	2	Low	1	Low	1
Wildfire	High	3	High	3	Low	1	High	3	High	3
Winter Storm	High	3	High	3	High	3	High	3	Low	1

**TABLE 18-4.
IMPACT ON ECONOMY FROM HAZARDS**

	Las Animas County		City of Trinidad		Town of Aguilar		Town of Cokedale		Stonewall FPD	
Hazard	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor	High/Med /Low/No	Probability Factor
Avalanche	No	0	Low	1	No	0	Low	1	Low	1
Dam/Levee Failure	Medium	2	High	3	Low	1	Low	1	Low	1
Drought	High	3	High	3	High	3	High	3	Medium	2
Earthquake	Medium	2	Medium	2	Low	1	High	3	Low	1
Erosion and Deposition	Low	1	Medium	2	Low	1	Low	1	Low	1
Expansive Soils	Low	1	Low	1	Low	1	Medium	2	Low	1
Extreme Heat	Low	1	Medium	2	Low	1	High	3	Low	1
Flood	Medium	2	High	3	Low	1	Low	1	Low	1
Hail	Medium	2	Medium	2	Low	1	High	3	Low	1
Landslide, Mud/Debris Flow, Rockfall	Low	1	Low	1	Low	1	Low	1	Low	1
Lightning	Low	1	Medium	2	Low	1	High	3	Low	1
Severe Wind	Medium	2	Medium	2	Low	1	Medium	2	Low	1
Subsidence	Low	1	Medium	2	Low	1	High	3	No	0
Tornado	Low	1	High	3	Low	1	Low	1	No	0
Wildfire	High	3	High	3	Low	1	High	3	High	3
Winter Storm	High	3	High	3	High	3	High	3	Low	1

18.3 RISK RATING AND RANKING

The risk rating for each hazard was calculated by multiplying the probability factor by the sum of the weighted impact factors for people, property and operations, as summarized in Table 18-5. Based on these ratings, a priority of high, medium, or low was assigned to each hazard. The hazards ranked as being of highest concern vary by jurisdiction but generally include drought, wildfire, and winter storm. Other hazards ranked as being of high or medium concern include dam failure, flood, hail, lightning, landslide, mud/debris flow, and rockfall, severe wind. The hazards ranked as being of lowest concern are avalanche, earthquake, erosion and deposition, expansive soils, subsidence, and tornado. Table 18-6 summarizes the hazard risk ranking.

**TABLE 18-5.
HAZARD RISK RANKING CALCULATIONS**

	Las Animas County			City of Trinidad			Town of Aguilar			Town of Cokedale			Stonewall FPD		
Hazard	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total
Avalanche	1	5	5	1	6	6	0	0	0	1	6	6	2	6	12
Dam/Levee Failure	2	12	24	2	15	30	1	6	6	1	6	6	1	6	6
Drought	3	18	54	3	18	54	2	16	32	3	18	54	2	7	14
Earthquake	3	12	36	3	14	42	2	9	18	3	18	54	3	11	33
Erosion and Deposition	2	6	12	2	12	24	1	6	6	1	6	6	2	6	12
Expansive Soils	1	6	6	2	6	12	1	6	6	2	12	24	2	6	12
Extreme Heat	2	11	22	3	12	36	1	6	6	3	18	54	1	6	6
Flood	2	12	24	3	15	45	1	6	6	1	6	6	2	6	12
Hail	3	17	51	3	12	36	2	10	20	3	18	54	2	11	22
Landslide, Mud/Debris Flow, Rockfall	2	6	12	2	6	12	1	6	6	1	6	6	2	6	12
Lightning	3	11	33	3	12	36	1	6	6	3	18	54	2	6	12
Severe Wind	3	12	36	3	12	36	2	6	12	2	12	24	2	6	12
Subsidence	1	6	6	2	12	24	1	6	6	3	18	54	1	5	5
Tornado	2	11	22	2	13	26	1	8	8	1	6	6	1	5	5
Wildfire	3	18	54	3	18	54	2	6	12	3	18	54	3	18	54
Winter Storm	3	18	54	3	18	54	3	18	54	3	18	54	3	6	18

Notes:
Impact Weighted Sum = Total Impact Factor People + Total Impact Factor Property + Total Impact Factor Economy
Total = Probability x Impact Weighted Sum

**TABLE 18-6.
HAZARD RISK SUMMARY**

Hazard	Las Animas County	City of Trinidad	Town of Aguilar	Town of Cokedale	Stonewall FPD
Avalanche	5	6	0	6	12
Dam/Levee Failure	24	30	6	6	6
Drought	54	54	32	54	14
Earthquake	36	42	18	54	33
Erosion and Deposition	12	24	6	6	12
Expansive Soils	6	12	6	24	12
Extreme Heat	22	36	6	54	6
Flood	24	45	6	6	12
Hail	51	36	20	54	22
Landslide, Mud Debris Flow, Rockfall	12	12	6	6	12
Lightning	33	36	6	54	12
Severe Wind	36	36	12	24	12
Subsidence	6	24	6	54	5
Tornado	22	26	8	6	5
Wildfire	54	54	12	54	54
Winter Storm	54	54	54	54	18

0 = No exposure (gray)
1 - 18 = L – Low (green)
19 – 36 = M – Medium (yellow)
37 – 54 = H - High (red)

PART 3— MITIGATION AND PLAN MAINTENANCE STRATEGY

CHAPTER 19.
MITIGATION ACTIONS AND IMPLEMENTATION

The Steering Committee reviewed a menu of hazard mitigation alternatives that present a broad range of alternatives to be considered for use in the planning area, in compliance with Title 44 Code of Federal Regulations (44 CFR) (Section 201.6(c)(3)(ii)). The menu reviewed for this plan is presented in Appendix D. The menu provided a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the partners to implement. The Steering Committee reviewed the full range of actions as well as the county's ability to implement the variety of mitigation actions. Hazard mitigation actions recommended in this plan were selected from among the alternatives presented in the menu as well as other projects known to be necessary.

19.1 RECOMMENDED MITIGATION ACTIONS

The planning partners and the Steering Committee identified actions that could be implemented to provide hazard mitigation benefits. Table 19-1 lists the recommended mitigation actions and the hazards addressed by the action. All of the hazards profiled in this plan are addressed by more than one mitigation action. Individual worksheets for each recommended action are provided in Appendix E.

Table 19-1 also provides the details of the mitigation actions, including the mitigation action description, the ranking, action type, estimated cost, potential funding sources, and timeline. Mitigation types used for this categorization are as follows:

Local Plans and Regulations (LPR) – These actions include government authorities, policies, or codes that influence the way land and buildings are being developed and built.

Structure and Infrastructure Projects (SIP) – These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct structures to reduce the impact of hazards.

Natural Systems Protection (NSP) – These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.

Education and Awareness Programs (EAP) – These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These initiatives may also include participation in national programs, such as StormReady and FireWise Communities.

The parameters for the timeline are as follows:

Short-Term – To be completed in 1 to 5 years

Long-Term – To be completed in greater than 5 years

Ongoing – Currently being funded and implemented under existing programs

Mitigation action worksheets were developed to provide more information for each recommended mitigation action, including the specific problem being mitigated, alternative actions considered, whether the action applies to existing or future development, the benefits or losses avoided, the department or office responsible for implementing the action, the local planning mechanism, and potential funding sources. These worksheets were developed to provide a tool for the planning partners to apply for grants or general funds to complete the mitigation action. An example worksheet for Las Animas County is shown in Figure 19-1.

Mitigation Action Worksheet

Please complete one worksheet per action with as much detail as possible, using the instructions provided and FEMA examples.

Name of Jurisdiction: ______________________ **Mitigation Action #:** ______________

Mitigation Action Title: ____

Assessing the Risk	
Hazard(s) addressed: (check all that apply)	☐All Hazards ☐Avalanche ☐Dam/Levee Failure ☐Drought ☐Earthquake ☐Erosion and Deposition ☐Expansive Soils ☐Extreme Heat ☐Flood ☐Hail ☐Landslide. Mud/Debris Flow, Rockfall ☐Lightning ☐Severe Wind ☐Subsidence ☐Tornado ☐Wildfire ☐Winter Storm
Specific problem being Mitigated (describe why action is needed)	
Evaluation of Potential Alternatives	
Alternatives Considered (name of project and reason for not selecting)	1.
	2.
	3.
Action/Project Intended for Implementation	
Describe how action will be implemented (main steps involved)	
Action/Project Type	☐Local Plans and Regulations ☐Structure and Infrastructure Project ☐Natural Systems Protection ☐Education and Awareness Programs
Applicable Goals/Objectives (refer to list of goals/objectives)	☐Goal #1 ☐Goal #2 ☐Goal #3 Objective:
Applies to existing or future development	☐ Existing Development ☐Future Development ☐ Both Existing and Future Development ☐Not Applicable
Describe benefits (losses avoided)	☐Life Safety ☐Damage Reduction ☐Other Describe:
Estimated Cost	☐ < $10,000; ☐$10,000 to $100,000; ☐>$100,000 Other Amount: $
Plan for Implementation	
Responsible Department	
Local Planning Mechanism (check all that apply)	☐Capital Improvement Plan ☐Comprehensive Plan ☐Building Code ☐Ordinance ☐Other:
Potential Funding Sources	
Timeline for Completion	☐ Short Term (1-5 yrs.) ☐ Long Term (>5 yrs.) ☐ Ongoing
Reporting on Progress	
Status/Comment	☐Not Started ☐In-progress ☐Delayed ☐Completed ☐No Longer Required Comment:
Completed by: (name, title, phone #)	**Date:**

Figure 19-1. Example Mitigation Action Worksheet

19.2 BENEFIT/COST REVIEW AND PRIORITIZATION

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by the Federal Emergency Management Agency (FEMA) for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) Grant Program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Fourteen criteria were used to assist in evaluating and prioritizing the mitigation initiatives. For each mitigation action, a numeric rank (0, 1, 2, 3, 4) was assigned for each of the 14 evaluation criteria defined as follows:

- Definitely Yes - 4
- Maybe Yes - 3
- Unknown/Neutral - 2
- Probably No - 1
- Definitely No - 0

The 14 evaluation/prioritization criteria are:

1. Life Safety—How effective will the action be at protecting lives and preventing injuries? The numeric rank for this criterion is multiplied by 2 to emphasize the importance of life safety when evaluating the benefit of the action.
2. Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure? The numeric rank for this criterion is multiplied by 2 to emphasize the importance of property protection when evaluating the benefit of the action.
3. Cost-Effectiveness—Will the future benefits achieved by implementing the action, exceed the cost to implement the action?
4. Technical—Is the mitigation action technically feasible? Will it solve the problem independently and is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
5. Political—Is there overall public support for the mitigation action? Is there the political will to support it?
6. Legal—Does the jurisdiction have the authority to implement the action?
7. Fiscal—Can the project be funded under existing program budgets (i.e., is this action currently budgeted for)? Or would it require a new budget authorization or funding from another source such as grants?
8. Environmental—What are the potential environmental impacts of the action? Will it comply with environmental regulations?
9. Social—Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

10. Administrative—Does the jurisdiction have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?
11. Multi-hazard—Does the action reduce the risk to multiple hazards?
12. Timeline—Can the action be completed in less than 5 years (within our planning horizon)?
13. Local Champion—Is there a strong advocate for the action or project among the jurisdiction's staff, governing body, or committees that will support the action's implementation?
14. Other Local Objectives—Does the action advance other local objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of other plans and programs?

The numeric results of this exercise are shown on the mitigation action worksheets in Appendix E. An example worksheet for is shown in Figure 19-2. These results were used to identify the benefit of the action to the community as low, medium, or high priority. Table 19-1 shows the priority of each mitigation action.

The Steering Committee used the results of the benefit/cost review and prioritization exercise to rank the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on Table 19-1, medium priority actions are shown in yellow and low priority actions are shown in green.

Prioritization Worksheet

Mitigation Action #: _______________

Mitigation Action Title: _______________

Criteria	Numeric Rank: Definitely Yes = 4; Maybe Yes = 3; Unknown/Neutral = 2; Probably No = 1; Definitely No = 0		Provide brief rationale for numeric rank when appropriate
1. Will the action result in Life Safety?		x 2 =	
2. Will the action result in Property Protection?		x 2 =	
3. Will the action be Cost-Effective? (future benefits exceed cost)			
4. Is the action Technically feasible			
5. Is the action Politically acceptable?			
6. Does the jurisdiction have the Legal authority to implement?			
7. Is Funding available for the action?			
8. Will the action have a positive impact on the natural Environment?			
9. Is the action Socially acceptable?			
10. Does the jurisdiction have the Administrative capability to execute the action?			
11. Will the action reduce risk to more than one hazard (Multi-Hazard)?			
12. Can the action be implemented Quickly?			
13. Is there an Agency/Department Champion for the action?			
14. Will the action meet other Community Objectives?			
Total			
Priority: Low = <35 Medium = 35-49 High = >50	☐Low ☐Medium ☐High		

Figure 19-2. Example Benefit/Cost Review and Prioritization Worksheet

TABLE 19-1.
RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Hazards Addressed	Action Type	Applicable Goals and Objectives	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline
LAS ANIMAS COUNTY										
1	Purchase Back-up Generators	The County will purchase two portable back-up generators for shelter locations.	12	Avalanche; Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	OEM	$10,000 to $100,000	County budget, FEMA HMA	Short Term
2	Construct New EOC	The County wants to move the EOC to a brick building at 1st and Maple that is a larger space and it is outside the 100-year floodplain. The building already houses the Trinidad Police Department.	1	Avalanche; Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	OEM	$10,000 to $100,000	FEMA HMA	Short Term

3	Evacuation Plan Including Functional and Access Needs Population	The County plans to develop and implement an Evacuation Plan that includes Functional and Access Needs Population. The County will work with the American Red Cross to get this completed.	2	Avalanche; Dam/Levee Failure; Flood; Tornado; Wildfire; Winter Storm	LPR EAP	Goal: 1, 3 Obj: 1.4, 3.1, 3.2	OEM	< $10,000	County budget, ARC	Short Term
4	Educate Homeowners on Drought Conservation Measures	The County will educate homeowners on drought conservation measures using the county website and public events.	10	Drought	EAP	Goal: 1, 2 Obj: 1.1, 2.1, 2.4	OEM	< $10,000	County Budget	Short Term
5	Purchase Crop Insurance	Preserve economic stability during drought and other natural hazard events by encouraging farmers to obtain crop insurance to cover potential losses due to the event. The County will provide educational materials at public events and in the county offices.	6	Drought, Flood, Hail, Lightning, Wildfire, Winter Storm	EAP	Goal: 2 Obj: 2.1	OEM	< $10,000	County budget	Long Term
6	Adopt 2015 IBC and IRC	The County will adopt the 2015 IBC and IRC standards.	8	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado;	LPR	Goal: 3 Obj: 3.1, 3.2	Building Dept.	< $10,000	County budget	Short Term

				Wildfire; Winter Storm						
7	Update FIRMs	The County will work with the Colorado Water Conservation Board to get FIRMs updated for the county.	7	Flood	LPR	Goal: 1, 3 Obj: 1.1, 1.3, 3.1	Department of Land Use/Land Use Officer	$10,000 to $100,000	County budget, CWCB, FEMA Risk MAP	Short Term
8	Perform Exercise on Trinidad Dam Emergency Action Plan	The County will work with the City of Trinidad to plan and execute an exercise on the Trinidad Dam Emergency Action Plan notification procedures and expected actions.	4	Dam Failure	LPR EAP	Goal: 1, 2, 3 Obj: 1.4, 2.2, 2.4, 3.1	OEM	< $10,000	County budget	Short Term
9	Purchase Outdoor Warning Siren	The County will purchase and install outdoor warning sirens for the Kim area to give homeowners proper warning time for weather events.	11	Hail; Lightning; Severe Wind; Tornado; Wildfire	SIP	Goal: 1 Obj: 1.1	OEM	$10,000 to $100,000	County Budget, FEMA HMA	Short Term

10	Create MOUs with Neighboring Counties	The County will develop and sign MOUs with neighboring counties to help with emergency assistance, in particular snow removal during blizzard events.	9	Avalanche; Dam/Levee Failure; Earthquake; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.2, 3.3	OEM	< $10,000	County Budget	Short Term
11	Install Lightning Rods on County Facilities	The County will purchase and install lightning rods to put on critical county facilities to protect from lightning damage.	5	Lightning	SIP	Goal: 1 Obj: 1.1, 1.2	OEM	< $10,000	County budget, state and federal grants	Short Term
12	Fire Protection Districts to Create, Maintain, and Implement CWPPs	The County will work with all the fire protection districts in Las Animas County to create, maintain, and implement CWPPs and implement wildfire mitigation measures to minimize the wildfire threat.	3	Wildfire	LPR	Goal: 1, 2 Obj: 1.1, 2.3	OEM	< $10,000	state and federal grants	Short Term
CITY OF TRINIDAD										
1	Retrofit Existing Dedicated Space for PD EOC	Upgrade the dedicated space with enough phone lines (26+), desks, tables, area for maps, internet, sleep quarters, showers, kitchen for food prep, televisions – in accordance with the EOP	1	Avalanche; Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 3 Obj: 3.3	Police Department	$10,000 to $100,000	Grants & CIP money	Short Term

2	Provide Back-up Generators for Critical Infrastructures	Purchase and install back-up generators at: 1) the two fire stations, 2) City Hall where the servers are stored (they operate our CAD/RMS systems that are used by all emergency services), and 3) Police Department to support/improve the redundant communication center.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1	City Public Safety Manager	$10,000 to $100,000	HMP Grants & CIP money	Short Term
3	Install Outdoor Warning Sirens	The City would like to purchase a minimum of 4, and up to 12, outdoor warning sirens to cover the entire city limits. Then the City can install and training personnel on the sirens. The City of Trinidad currently has no outdoor warning sirens.	8	Avalanche; Dam/Levee Failure; Earthquake; Flood; Hail; Lightning; Severe Wind; Tornado; Wildfire	SIP	Goal: 1 Obj: 1.2	Fire / Police Department	>$100,000	Grants (CIP Matching)	Short Term
4	Upgrade Emergency Shelters to Meet Functional and Access Needs Standards	The existing emergency shelters (Trinidad Community Center and Sayre Senior Center) need to meet or exceed the needs of the entire population to include functional and access needs in order to reduce the long-term risks to loss of life from natural disasters as well as satisfy state and local regulations.	2	Avalanche; Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, Obj: 1.1, 1.4	City Public Safety Manager	>$100,000	Capital Improvement Funds & Grants	Short Term

5	Wildfire Education and Awareness Programs	Schedule workshops for residents and advertise with flyers, ads, and radio. The workshops would provide education to residents on how to protect themselves, their property and their community from wildfire-urban interface.	9	Wildfire	EAP	Goal: 2 Obj: 2.3	Fire Department	< $10,000	State and Federal Grants	Ongoing
6	Localized Flood Reduction Project	The City of Trinidad shall minimize debris and back-up in drainage areas by maintaining and removing debris near or on localized dam areas.	10	Dam/Levee Failure, Flood	SIP	Goal: 1, 2 Obj: 1.1, 2.2	City Public Safety Manager	$10,000 to $100,000	Budgetary line expenses, Capital Improvement Funds & Grants	Short Term
7	Upgrade Electrical Infrastructure	The City of Trinidad will: 1) mitigate and bury overhead electrical lines, 2) fortify substation upgrades, 3) voltage conversions, and 4) maintain and upgrade existing underground facilities as needed.	7	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds & Grants	Long Term

8	Upgrade Utility Sewer Infrastructure	The City of Trinidad will: 1) remove old ductile iron, and asbestos cement pipelines and replace with Schedule 35 plastic pipe, 2) fortify sewer lift stations, 3) install two additional lift stations within collection system and Mission Control System, 4) upgrade the existing SCADA system, and 5) maintain and upgrade existing underground facilities as needed.	6	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds & Grants	Long Term
9	Upgrade Utility Water Infrastructure	The City of Trinidad will: 1) remove old galvanized, cast iron, steel, ductile iron, and asbestos cement pipelines and replace with C-900 pipelines, 2) fortify water pump stations, 3) fortify regulating stations, 4) fortify water storage tanks, and 5) maintain and upgrade existing underground facilities as needed.	4	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds & Grants	Long Term
10	Upgrade Gas Utility Infrastructure	The City of Trinidad will: 1) remove all steel pipelines and uncoated gas pipelines, 2) fortify gas regulating stations, 3) fortify and redesign existing power plant regulating station, and 4) maintain and upgrade existing underground facilities as needed.	5	Dam/Levee Failure; Erosion and Deposition; Expansive Soils; Flood; Subsidence	SIP	Goal: 1, Obj: 1.1, 1.2	Utilities Director	>$100,000	Capital Improvement Funds & Grants	Long Term
TOWN OF AGUILAR										

1	Purchase Back-up Generator	The Town of Aguilar will purchase and install a permanent back-up generator for the Aguilar Housing Authority that has 18 residential units.	1	Dam/Levee Failure; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.1, 1.4	Town Clerk	$10,000 to $100,000	FEMA's HMA grants	Short Term
2	Registry Database for Functional and Access Needs	The Town of Aguilar will create and implement a registry database for the functional and access needs population to register their needs. This will allow the Marshal and volunteers to assist those in need during and after a hazard event.	4	Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.4	Town Clerk	< $10,000	Town budget, state grants, ARC	Short Term
3	Create a CERT team	The Town of Aguilar will enlist a CERT group of volunteers under the direction of the Marshal to check-in on and assist the functional and access needs population that have registered with the Town.	3	Dam/Levee Failure; Drought; Earthquake; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Tornado; Wildfire; Winter Storm	LPR	Goal: 1, 3 Obj: 1.4, 3.2	Marshal's Office	< $10,000	Town budget, state grants	Short Term
4	Create MOA for Emergency Water	The Town of Aguilar will create a MOA with the Cities of Trinidad and Walsenburg for drinking water. The MOA could then be executed in times of need as a secondary potable water source.	5	Drought	LPR	Goal: 1, 3 Obj: 1.1, 3.1, 3.3	Town Clerk	< $10,000	Town budget, state grant	Short Term

5	Create and Implement a Drought Response Plan	The Town of Aguilar will create and implement a Drought Response Plan with drought stage contingency measures. The plan's drought stage measures would be adopted by the town and the residents would be required to adhere to the drought stage measures.	2	Drought	LPR EAP	Goal: 1, 2 Obj: 1.1, 2.4	Town Clerk	< $10,000	Town budget	Short Term
6	Hail Education to Homeowners	The Town of Aguilar will educate homeowners about the dangers of hail and how to mitigate hail damage with hail-resistant roof coverings, flashing in building designs, etc.	6	Hail	EAP	Goal: 1, 2 Obj: 1.1, 2.1	Town Clerk	< $10,000	Town budget	Short Term
TOWN OF COKEDALE										
1	Hardening and Retrofitting the Mercantile Building for Use as an EOC	Engineer, design, and construct a retrofitted and hardened EOC for the town. The Mercantile building will be retrofitted and hardened by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire-resistant plants; implementing higher	1	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, 3 Obj: 1.2, 3.1	Town of Cokedale/ Administration	>$100,000	FEMA, HMA, DOLA, CDBG	Short Term

		standards for foundations, and using R-value building materials to resist heat.								
2	Public Education of all Hazards	Supply educational pamphlet to residents so they can mitigate their homes from natural hazard events.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	EAP	Goal: 2 Obj: 2.1, 2.4	Town Clerk	< $10,000	State and federal grants	Short Term
3	Back-up Generator	The Town of Cokedale will purchase and install back-up generators for the waste water lagoons, the training center, and the Mercantile Building.	2	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1 Obj: 1.2	Town Clerk	$10,000 to $100,000	State and federal grants	Short Term
4	Create Defensible Space Around Homes	Educate and provide man-power to assist homeowners with clearing space around their property to mitigate wildfires.	4	Wildfire	EAP NSP	Goal: 1, 2, 3 Obj: 1.1, 2.3, 3.3	Town Clerk	< $10,000	State and federal grants	Short Term

5	Thin Brush and Trees	Provide the man-power and tools to clear brush and dead trees that can be ignited in a wildfire.	5	Wildfire	EAP NSP	Goal: 1, 2, 3 Obj: 1.1, 2.3, 3.3	Town Clerk	< $10,000	State and federal grants	Short Term
STONEWALL FIRE PROTECTION DISTRICT										
1	Wildfire Education	This jurisdiction is a wildland urban interface, covering 547 sq. miles of which 75% is overgrown forest sloping down into oak brush, sage and grasses. The FPD will work with their current CWPP to provide education and information programs such as partnerships with Landowner Associations and Homeowner Associations to implement addition CWPP, fire prevention education program in the schools, the public, and incessant work with the Colorado State Forest Service.	1	Wildfire	EAP	Goal: 1, 2, 3 Obj: 1.1, 1.3, 2.1, 2.3, 3.1	Stonewall Fire Protection District, Central Office	< $10,000	FEMA, USDA, State Forestry Dept.	Ongoing
2	Wildfire Thinning Brush	Coordinate thinning of the forest on public and private lands at priority locations within the FPD once a grant is secured.	2	Wildfire	NSP	Goal: 1, 3 Obj: 1.1, 1.3, 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	FEMA, USDA, State Forestry Dept.	Short Term

3	Construct Hardened Central Fire Station	The District will hire a contractor to engineer, design, and construct a hardening fire station. The fire station will be hardened to withstand seismic activity, wind, hail, winter storm by applying a higher standard for the foundation and upgrading the requirements on the construction of beams, supports, roof, bay doors, insulation, installing lighting rods and grounding systems; using low-flow plumbing to conserve water; landscape with drought and fire resistant plants; and using R-value building materials to resist heat. The Central Station will also serve as an emergency facility to facilitate community needs such as power, water, and a safe place to congregate before, during, and after a hazardous event.	3	Avalanche; Dam/Levee Failure; Drought; Earthquake; Erosion and Deposition; Expansive Soils; Extreme Heat; Flood; Hail; Landslide, Mud/Debris Flow, and Rockfall; Lightning; Severe Wind; Subsidence; Tornado; Wildfire; Winter Storm	SIP	Goal: 1, 3 Obj: 1.1, 1.3, 1.4, 3.1	Stonewall Fire Protection District, Central Office	>$100,000	FEMA, USDA, State Forestry Dept.	Short Term
4	Earthquake Education	Incorporate earthquake awareness and information into our current outreach programs. Continue to monitor earthquake data and share information with the public. Develop strategies to implement post-disaster	4	Earthquake	EAP	Goal: 2 Obj: 2.1	Stonewall Fire Protection District, Central Office	< $10,000	FEMA, district funds	Ongoing

		actions. County planning and zoning to implement and enforce upgraded building codes.								
5	Lightning Education	Educate with printed materials the public and fire fighters with data on life safety during storms.	5	Lightning	EAP	Goal: 2 Obj: 2.1	Stonewall Fire Protection District, Central Office	< $10,000	Local funds	Ongoing
6	Dam Failure Education	Provide dam failure and flood hazard education for the public by mailings of brochures, handing out information at events, i.e.; Trinidad Water Festival to mitigate damages to property and homes.	8	Dam/Levee Failure; Flood	EAP	Goal: 2 Obj: 2.2	Stonewall Fire Protection District, Central Office	< $10,000	Local funds	Ongoing
7	Severe Wind Property Assessments	Provide home and property assessments for potential wind damage to ranchers and homeowners in the district. Public education to homeowners on mitigating homes and properties for the potential of wind damage.	6	Severe Wind, Tornado	EAP	Goal: 1, 3 Obj: 1.1, 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	District Funds	Short Term
8	Winter Storm Education	Provide public education and information to homeowners on winter weather mitigation measures for their homes and property. Also offer assessments and mitigation of properties for winter storms.	7	Winter Storm	EAP	Goal: 3 Obj: 3.1	Stonewall Fire Protection District, Central Office	$10,000 to $100,000	FEMA, USDA	Ongoing

ARC	American Red Cross	FPD	Fire Protection District
CDBG	Community Development Block Grant	HMA	Hazard Mitigation Assistance grants
CERT	Community Emergency Response Team	IBC	International Building Code
CIP	Community Improvement Plan	IRC	International Residential Code
CWCB	Colorado Water Conservation Board	LPR	Local Plans and Regulations
CWPP	Community Wildfire Protection Plan	MOA	Memorandum of Agreement
DFIRM	Digital Flood Insurance Rate Map	MOU	Memorandum of Understanding
DOLA	Colorado Department of Local Affairs	NSP	Natural System Protection
EAP	Education and Awareness Programs	OEM	Office of Emergency Management
EOC	Emergency Operations Center	PD	Police Department
EOP	Emergency Operations Plan	SIP	Structure and Infrastructure Project
FEMA	Federal Emergency Management Agency	USDA	U.S. Department of Agriculture
FIRM	Flood Insurance Rate Map		

CHAPTER 20.
PLAN ADOPTION AND MAINTENANCE

20.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. All planning partners fully met the participation requirements specified by the Steering Committee and will seek Disaster Mitigation Act (DMA) compliance under this plan. The plan will be submitted for a pre-adoption review to Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA Region VIII prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix F.

20.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle.
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the *Las Animas County Hazard Mitigation Plan* remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every 5 years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

20.2.1 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions' existing plans, policies, and programs. Together, the action items in the plan provide a framework for activities that the partnership can implement over the next 5 years. The planning team and the Steering Committee have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

The Las Animas County Office of Emergency Management (OEM) will have lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all planning partnership members and agencies identified as lead agencies in the mitigation action plans.

20.2.2 Steering Committee

The Steering Committee is a total volunteer body that oversaw the development of the plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the Steering Committee's position that an implementation committee with representation similar to the initial Steering Committee should have an active role in the plan maintenance strategy. Therefore, it is recommended that a Steering Committee remain a viable body involved in key elements of the plan maintenance strategy. The new Steering Committee should strive to include representation from the planning partners, as well as other stakeholders in the planning area.

The principal role of the new implementation committee in this plan maintenance strategy will be to review the annual progress report and provide input to the Las Animas County Emergency Manager on possible enhancements to be considered at the next update. Future plan updates will be overseen by a Steering Committee similar to the one that participated in this plan development process, so keeping an interim Steering Committee intact will provide a head start on future updates. Completion of the progress report is the responsibility of each planning partner, not the responsibility of the Steering Committee. It will simply be the Steering Committee's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

20.2.3 Annual Progress Report

The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to evaluate whether the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation

The planning team has created a template to guide the planning partners in preparing a progress report (see Appendix G). The plan maintenance Steering Committee will provide feedback to the planning team on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Las Animas County OEM website page dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to planning partner governing bodies to inform them of the progress of initiatives implemented during the reporting period

The county and the planning partners do not currently participate in the Community Rating System (CRS). However, if any of the planning partners decide to participate in CRS in the future, the report can be provided as part of the CRS annual re-certification package. The CRS requires an annual recertification to be submitted by October 1 of every calendar year for which the community has not received a formal audit. To meet this recertification timeline, the planning team will strive to complete progress reports between June and September each year.

Uses of the progress report will be at the discretion of each planning partner. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other partners.

20.2.4 Plan Update

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The Las Animas County partnership intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the county or participating city/town's comprehensive plan

It will not be the intent of future updates to develop a complete new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a Steering Committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The partnership governing bodies will adopt their respective portions of the updated plan.

20.2.5 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Las Animas County OEM's website and by providing copies of annual progress reports to the media. The Las Animas County OEM will maintain the hazard mitigation plan website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Copies of the plan will be distributed to the public library system in Las Animas County Library. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Steering Committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

20.2.6 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The comprehensive plans, zoning and subdivision regulations, and ordinances of Las Animas County and the partner cities/towns are considered to be integral parts of this plan. The county and partner municipalities, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided the county and the cities/towns with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual comprehensive plans. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

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APPENDIX A. ACRONYMS AND DEFINITIONS

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

§	Section
°F	Degrees Fahrenheit
°C	Degrees Celsius
%g	Percentage of gravity
44 CFR	Title 44 of the Code of Federal Regulations
BLM	Bureau of Land Management
BOCC	Board of County Commissioners
CAIC	Colorado Avalanche Information Center
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CO-WRAP	Colorado Wildfire Risk Assessment Program
CRS	Community Rating System
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWPP	Community Wildfire Protection Plan
DHSEM	Colorado Division of Homeland Security and Emergency Management
DFIRM	Digital Flood Insurance Rate Map
DHS	Department of Homeland Security
DMA	Disaster Mitigation Act
EAP	Education and Awareness Programs
EF	Enhanced Fujita
EM	Emergency Loans
EMS	Emergency Medical Services
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FoCAIC	Friends of the Colorado Avalanche Information Center

FPD	Fire Protection District
FSA	Farm Service Agency
FY2016	Fiscal Year 2016
GIS	Geographic Information System
HAZMAT	Hazardous Materials
HAZUS-MH	Hazards, United States-Multi Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
LPR	Local Plans and Regulations
ML	Local Magnitude Scale
MM	Modified Mercalli Scale
mph	Miles per Hour
M_W	Moment Magnitude
NASA	National Aeronautics and Space Administration
NEHRP	National Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSSA	National Storm Shelter Association
NSP	Natural Systems Protection
NWS	National Weather Service
OEM	Office of Emergency Management
OTA	Congressional Office of Technology Assessment
PDM	Pre-Disaster Mitigation
PDI	Palmer Drought Index
PGA	Peak Ground Acceleration
PHDI	Palmer Hydrological Drought Index
SIP	Structure and Infrastructure Project
SFHA	Special Flood Hazard Area
SFPD	Stonewall Fire Protection District
SPI	Standardized Precipitation Index
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

WUI Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1% annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit/cost analysis of proposed mitigation measures, benefits are limited to specific, measurable risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic or water reactive materials.
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events.
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65%.

Disaster Mitigation Act of 2000 (DMA): The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's FIRM. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A FIRM identifies most, but not necessarily all, of a community's floodplain as the SFHA.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1% chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour [mph]) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass Movement: A collective term for landslides, mudflows, debris flows, sinkholes, and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Initiatives (or Mitigation Actions): Mitigation initiatives are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a FIRM. The SFHA is mapped as a Zone A in riverine situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams, and drains where banks have been eroded, sloughed, or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: Wildfire refers to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B.
LOCAL MITIGATION PLAN REVIEW TOOL

APPENDIX B.
LOCAL MITIGATION PLAN REVIEW TOOL

This appendix presents the local mitigation action review tool for the *Las Animas County Hazard Mitigation Plan*. The review tool demonstrates how the plan meets federal regulations and offers state and FEMA planners an opportunity to provide feedback on the plan to the community.

APPENDIX C.
PUBLIC OUTREACH

APPENDIX C.
PUBLIC OUTREACH

This appendix includes the agenda, sign-in sheets, and meeting notes from the three Steering Committee Meetings conducted in 2015. This appendix also include the results of the *Las Animas County Hazard Mitigation Plan* questionnaire, as described in Chapter 2.7.2. The press releases announcing the development of the *Las Animas County Hazard Mitigation Plan* are shown in Chapter 2.7.4.

APPENDIX D.
MENU OF MITIGATION ALTERNATIVES

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MENU OF MITIGATION ALTERNATIVES

Mitigation Categories

The measures that communities and individuals can use to protect themselves from, or mitigate the impacts of, natural and man-made hazards fall into six categories:

1. Life Safety
2. Public Education and Awareness
3. Preventive Measures
4. Structural Projects
5. Property Protection
6. Natural Resource Protection

SAMPLE MITIGATION INITIATIVES:

***Hazard:* All Hazards**

- Incorporate an Emergency Telephone Notification System (ETNS) into the County Emergency Communications Center
- Construct a new Emergency Operations Center
- Develop a Master Generator Plan for the County
- Public Education & Information Program Development
- Develop a Special Needs registry through the 9-1-1 databases to assist with educating, alerting, evacuating, or responding to vulnerable populations during disaster
- Provide for back-up power sources for County essential services facilities to avoid water shortages during extended power outages
- Provide backup power generators to additional County fueling facilities
- Develop enhanced Emergency Planning for Special Needs populations in the County Emergency Operations Plan and other planning documents
- Work with County Businesses to develop a Disaster Resistant Business Program
- Develop a comprehensive public education program on the dangers of carbon monoxide during extended power outages
- Develop multi-lingual disaster education PSA's and educational videos
- Develop a separate "public safety" information area in all public libraries and public recreation facilities to disseminate disaster safety information appropriate to the area and the season
- Train/educate builders, developers, architects and engineers in techniques of disaster-resistant homebuilding
- Develop and begin to implement a systematic process to evaluate and upgrade aging infrastructure such as transportation, drainage, utilities, and others that could be affected during a major natural disaster.
- Collaborate with other stakeholders (public, businesses, non-profit organizations, government, regulatory agencies, and others) for public outreach efforts.
- Continue the public outreach strategy to share responsibilities amongst the citizens, federal, state, and local governments.
- Develop and maintain the County's Office of Emergency Management natural hazards website.
- Continue to pursue additional grants to implement risk reduction projects.
- Develop preparedness guides for County residents and businesses.
- Continue to improve the communication of severe weather warnings, flood warning, and related information.

- Distribute NOAA weather radios to residents that are most vulnerable to severe weather.
- Determine which critical facilities currently have weather radios and feasibility of hard-wiring.
- Develop an improved critical facilities dataset to use in emergency planning efforts and in future mitigation plan update.
- Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.

Hazard: Floods, Dam/Levee Failure

- Evaluate repetitive loss properties and potential solutions to mitigate existing conditions.
- Continue National Flood Insurance Program (NFIP) and improve the county's Community Rating System (CRS) classification. Examine criteria and establish roles and responsibilities for completion.
- Acquire and remove repetitive loss properties and repeatedly flooded properties acquisition will be the most cost effective and desirable mitigation measure
- Implement structural and non-structural flood mitigation measures for flood-prone properties, as recommended in the basin-wide master drainage plans
- Develop a Dam/Levee Public Education and Evacuation Plan for targeted areas of the community
- Continue to update and revise Basin-wide Master Drainage Plans where changed conditions warrant revisions.
- Develop an outreach program aimed at identifying and assisting private dam owners with repairing or decommissioning at-risk dams.
- Provide stricter floodplain regulations along the stream and river corridors.
- Consider establishing an administrative procedure or change in City and County codes for requiring builders to develop a site drainage plan ensuring "no adverse impact" when they apply for permits for new residential construction.
- Complete GIS and other automated inventories for stormwater, problem drainage areas, DFIRM and other assets.
- Review compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.

Hazard: Tornadoes, High Winds

- Develop a model SafeRoom project for [Mobile Home Park] in the County
- Develop a SafeRoom plan for County facilities
- Evaluate individual SafeRoom rebate program
- Educate residents, building professionals and SafeRoom vendors on the ICC/NSSA "Standard for the Design and Construction of Storm Shelters" and consider incorporating into current regulatory measures

Hazard: Lightning

- Install Lightning Warning & Alert Systems in public recreation areas

Hazard: Expansive Soils

- Research the applicability of establishing an administrative procedure or change in County codes for requiring builders to check for expansive soils when they apply for permits for new residential construction and for using foundations that mitigate expansive soil damages when in a moderate or high-risk area.

Hazard: Extreme Heat

- Review the safety of playground materials during extreme heat events
- Identify shelters or facilities for vulnerable populations to congregate during extreme weather events.

Hazard: Wildfire

- Implement a Firewise Community Education and Information Program
- Continue to develop partnerships with other organizations to implement wildfire mitigation plans and other hazard reduction programs.

- Complete and maintain a Community Wildfire Protection Plan including the assessment of parcels identified in the wildland urban interface.
- Work with Colorado Forestry Association and Department of Natural Resources to review zoning and ordinances to identify areas to include wildfire mitigation principles.

Hazard: **Earthquake**

- Incorporate earthquakes in the Office of Emergency Management public outreach strategy.
- Work with Colorado Geological to continue the study and analyze earthquakes related to appropriate levels of seismic safety in building codes and practices.

Hazard: **Avalanche**

- Ensure hazard maps are current and updated on a regular basis
- Enact tools to help manage development in hazard areas: better land controls, tax incentives, information
- Develop strategy to take advantage of post-disaster opportunities as they arise
- Continue to educate the public on the avalanche hazard and appropriate risk reduction alternatives.

Hazard: **Drought**

- Develop a public education on drought resistance
- Identify alternative water supplies for time of drought. Mutual aid agreements with alternative suppliers.
- Consider providing incentives to property owners that utilize drought resistant landscapes in the design of their homes.
- Develop standards that require drought resistant landscapes on County and community owned facilities
- Implement storm water retention in regions ideally suited for groundwater recharges.
  Develop a residential and local business program to modify plumbing systems – i.e. water saving kits

APPENDIX E.
WORKSHEETS FOR RECOMMENDED MITIGATION ACTIONS

APPENDIX E.
WORKSHEETS FOR RECOMMENDED MITIGATION ACTIONS

The planning partners and the Steering Committee determined that some actions could be implemented to provide hazard mitigation benefits. The individual worksheets for each recommended action are provided in this appendix.

APPENDIX F.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

APPENDIX F.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

To Be Provided With Final Release

APPENDIX G.
EXAMPLE PROGRESS REPORT

APPENDIX G.
EXAMPLE PROGRESS REPORT

Las Animas County
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: 2016-2017

Background: Las Animas County and participating communities in the county developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the county, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

http://Las Animascounty.org/Emergency-Management

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2016, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ______, 2021. As of this reporting period, the performance period for this plan is considered to be __% complete. The *Las Animas County Hazard Mitigation Plan* has targeted 41 hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

__ out of __ initiatives (__%) reported ongoing action toward completion.

__ out of __ initiatives (__%) were reported as being complete.

__ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the *Las Animas County Hazard Mitigation Plan*. The objective is to ensure that there is a continuing and responsive planning process that will keep the hazard mitigation plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Las Animas County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 201_. It was determined through the plan's development process that a Steering Committee would remain in service to oversee maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

TABLE 1.
STEERING COMMITTEE MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

____

____

____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the *Las Animas County Hazard Mitigation Plan* for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

Was any element of the initiative carried out during the reporting period?

If no action was completed, why?

Is the timeline for implementation for the initiative still appropriate?

If the initiative was completed, does it need to be changed or removed from the action plan?

TABLE 2.
ACTION PLAN MATRIX

Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status	Status (√, O, X)
LAS ANIMAS COUNTY						
1	Purchase Back-up Generators					
2	Construct New EOC					
3	Evacuation Plan Including Functional and Access Needs Population					
4	Educate Homeowners on Drought Conservation Measures					
5	Purchase Crop Insurance					
6	Adopt 2015 IBC and IRC					
7	Update FIRMs					
8	Perform Exercise on Trinidad Dam Emergency Action Plan					
9	Purchase Outdoor Warning Siren					
10	Create MOUs with Neighboring Counties					
11	Install Lightning Rods on County Facilities					
12	Fire Protection Districts to Create, Maintain, and Implement CWPPs					
CITY OF TRINIDAD						
1	Retrofit Existing Dedicated Space for PD EOC					
2	Provide Back-up Generators for Critical Infrastructures					
3	Install Outdoor Warning Sirens					

TABLE 2.
ACTION PLAN MATRIX

Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status	Status (√, O, X)
4	Upgrade Emergency Shelters to Meet Functional and Access Needs Standards					
5	Wildfire Education and Awareness Programs					
6	Localized Flood Reduction Project					
7	Upgrade Electrical Infrastructure					
8	Upgrade Utility Sewer Infrastructure					
9	Upgrade Utility Water Infrastructure					
10	Upgrade Gas Utility Infrastructure					
TOWN OF AGUILAR						
1	Purchase Back-up Generator					
2	Registry Database for Functional and Access Needs					
3	Create a CERT team					
4	Create MOA for Emergency Water					
5	Create and Implement a Drought Response Plan					
6	Hail Education to Homeowners					
TOWN OF COKEDALE						
1	Hardening and Retrofitting the Mercantile Building for Use as an EOC					
2	Public Education of all Hazards					
3	Back-up Generator					

TABLE 2.
ACTION PLAN MATRIX

Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status	Status (√, O, X)
4	Create Defensible Space Around Homes					
5	Thin Brush and Trees					
STONEWALL FIRE PROTECTION DISTRICT						
1	Wildfire Education					
2	Wildfire Thinning Brush					
3	Construct Hardened Central Fire Station					
4	Earthquake Education					
5	Lightning Education					
6	Dam Failure Education					
7	Severe Wind Property Assessments					
8	Winter Storm Education					

Completion status legend:

✓= Project Completed

O = Action ongoing toward completion

X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

____

____

____

____

____

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Las Animas County Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here