CITY OF COLORADO SPRINGS

Hazard Mitigation Plan

2016

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Acknowledgements

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Colorado Springs Information Technology Department

Colorado Springs Office of Emergency Management

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Colorado Springs Police Department

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Colorado Springs Utilities

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El Paso County Sheriff's Office

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Pikes Peak Regional Building Department

South Central Region Healthcare Coalition

South Central Region Voluntary Organizations Active in Disaster

University of Colorado at Colorado Springs

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Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
BMPs	Best Management Practices
BAER	Burn Area Emergency Response
BNSF	Burlington Northern Santa Fe
CDPHE	Colorado Department of Public Health and Environment
CDOT	Colorado Department of Transportation
CGS	Colorado Geological Survey
CIAC	Colorado Information Analysis Center
CSFD	Colorado Springs Fire Department
CSPD	Colorado Springs Police Department
CSU	Colorado Springs Utilities
CWCB	Colorado Water Conservation Board
CRS	Community Rating System
CWPP	Community Wildfire Protection Plan
cfs	Cubic Feet per Second
DFIRM	Digital Flood Insurance Rate Maps
DHSEM	Colorado Division of Homeland Security and Emergency Management
DMA 2000	Disaster Mitigation Act of 2000
EAP	Emergency Action Plan
EF Scale	Enhanced Fujita Scale
EMAP	Emergency Management Accreditation Program
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPCPH	El Paso County Public Health
EPCRA	Emergency Planning & Community Right-to-Know Act of 1986
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FM	Fire Marshal
FMA	Flood Mitigation Assistance
FSA	Farm Service Agency
F Scale	Fujita Scale
GARR	Gauge-Adjusted Radar Rainfall System
GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HOA	Homeowner Association
HUD	Department of Housing and Urban Development
IT	Information Technology

IPAWS	Integrated Public Alert and Warning System
LEPC	Local Emergency Planning Committee
LPC	Local Planning Committee
MSA	Metropolitan Statistical Area
NASA	National Aeronautics and Space Administration
NCA	U.S. National Climate Assessment
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NPMS	National Pipeline Mapping System
NWS	National Weather Service
OEM	Office of Emergency Management
Ord.	Ordinance
PDM	Pre-Disaster Mitigation
PDMP	Pre-Disaster Mitigation Plan
PERI	Public Entity Risk Institute
PIO	Public Information Office
PPRBD	Pikes Peak Regional Building Department
PPWPP	Pikes Peak Wildfire Prevention Partners
RFC	Repetitive Flood Claims
RL	Repetitive Loss
SEOP	State Emergency Operations Plan
sf	Square Footage
SFHA	Special Flood Hazard Area
SHELDUS	Spatial Hazard Events and Losses Database for the United States
SMEs	Subject Matter Experts
SOVI	Social Vulnerability Index
SRL	Severe Repetitive Loss
STAPLEE	Social, Technical, Administrative, Political, Legal, Environmental, and Economic
TORRO	Tornado and Storm Research Organisation
TRI	Toxic Release Inventory
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
U.S.	United States
USGS	U.S. Geological Survey
WARSSS	Watershed Assessment of River Stability and Sediment Supply
WHINFOE	Wildfire Hazard Information Extraction Model
WM	Wildfire Mitigation
WUI	Wildland Urban Interface

Adoption

RESOLUTION NO. 41-16

A RESOLUTION ADOPTING THE 2016 HAZARD MITIGATION PLAN FOR THE CITY OF COLORADO SPRINGS

WHEREAS, The City of Colorado Springs Office of Emergency Management ("City OEM") with the assistance from AECOM Technical Services, Inc., has gathered information and prepared the 2016 Hazard Mitigation Plan; and

WHEREAS, the 2016 Hazard Mitigation Plan has been prepared in accordance with Federal Emergency Management Agency ("FEMA") requirements at 44 C.F.R. 201.6; and

WHEREAS, the 2016 Hazard Mitigation Plan establishes a strategy to eliminate or reduce long-term risks to people and properties due to natural and human-caused hazards; and

WHEREAS, the City has afforded the citizens an opportunity to comment and provide input on the 2016 Hazard Mitigation Plan; and

WHEREAS, the Colorado Springs City Council has reviewed the Hazard Mitigation Plan and directs that the Hazard Mitigation Plan will be updated no less than every five years.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF COLORADO SPRINGS:

Section 1. The 2016 Hazard Mitigation Plan prepared by the City OEM as this City's Multi-Hazard Mitigation Plan is approved and ratified.

Section 2. The Mayor is authorized to execute the adopted 2016 Hazard Mitigation Plan. The City OEM Director is authorized to oversee implementation of the 2016 Hazard Mitigation Plan for the City.

Section 3. The City Clerk is directed to attest the Council President's signature on this Resolution and affix the seal of the City.

DATED at Colorado Springs, Colorado, this 26th day of April, 2016.

Council President

ATTEST:

Sarah B. Johnson, City Clerk

COLORADO SPRINGS INCORPORATED SEAL COLORADO

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Executive Summary

The purpose of the Colorado Springs Hazard Mitigation Plan update process was to evaluate the long-term risks to people and properties due to hazards and to prepare strategies to reduce these risks. This multi-hazard mitigation plan (hereinafter the "Plan") was developed by the City of Colorado Springs to reduce future losses to the community caused by hazards.

The Plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 to achieve eligibility for the Federal Emergency Management Agency (FEMA) hazard mitigation grant programs including:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

This Plan also reflects a planning and coordination process that positions the City to seek funding from post-disaster sources such as Public Assistance Mitigation (Section 406) and Department of Housing and Urban Development (HUD) Community Development Block Grants Disaster Recovery funds. This revised Plan updates the 2010 and 2005 Hazard Mitigation Plans for Colorado Springs, Colorado (formerly called the Pre-Disaster Mitigation Plans or PDMP and referred to as the 2005 or 2010 Plan). This update is a single-jurisdictional plan which covers the City of Colorado Springs.

Through the leadership of the Colorado Springs Office of Emergency Management (OEM), the Colorado Springs HMP Local Planning Committee (LPC) was reconvened from the former Planning Subcommittee with new membership where applicable and organized to assist with the development of this Plan including data collection, public input on history, community assets and strategies, and identification of preferred mitigation alternatives. This Plan represents the collective work of the citizens, elected and appointed officials, and other stakeholders in Colorado Springs.

Since the 2010 Plan was approved, the City has experienced its most significant disasters in recent history including the historic Waldo Canyon and Black Forest Fires (2012 and 2013, respectively), as well as flooding in September 2013 and May/June 2015. All of these events resulted in Presidential Disaster Declarations and the City has engaged in multiple mitigation initiatives and actions as a result of these events (See Section 6.4 for a summary).

The LPC has re-evaluated the identified hazards and determined that the hazards of concern should be reorganized and grouped by similar types. This grouping makes it more effective in communicating risk, goals, and mitigation actions with the Plan's stakeholders and the public. It is also beneficial in formulating strategies and conducting a more efficient and actionable planning process. Significant detail continues to be provided for the different types of hazard impacts under each larger hazard (e.g., hail for severe weather). This Plan also includes a significantly more robust evaluation of human-caused hazards than the 2010 Plan. Climate change is considered as it relates to the identified hazards. The following hazards were profiled in this Plan update:

- Flood and Dam/Levee Failure
- Geologic Hazards including Earthquake, Landslide, Subsidence, and Rockfall
- Severe Weather which includes Hail, Lightning, Windstorm, Tornado, Severe Winter Storm, and Drought
- Wildfire
- Human-caused hazards including Hazardous Materials Incidents, Terrorism and Infectious Disease

The results of the risk assessment for identifying probability and magnitude of these hazards in the City of Colorado Springs are summarized below.

Hazard	Probability	Magnitude	Risk Ranking
Wildfire	Likely	Critical	1
Severe Weather (Drought, Hail, Lightning, Tornado, Windstorm, and Severe Winter Storm)	Highly Likely	Limited to Critical	2
Flood and Dam/Levee Failure	Likely and Unlikely	Critical to Catastrophic	3
Human-Caused Hazards (Hazardous Materials, Infectious Disease, and Terrorism)	Occasional	Limited to Critical	4
Geologic Hazards (Earthquake and Landslides)	Occasional to Likely	Limited to Critical	5

OEM, the LPC, and stakeholders used the risk and vulnerability assessment to develop a citywide mitigation strategy through a list of goals, objectives, and actions. OEM carefully reviewed the goals and objectives from the 2010 Plan and updated them for 2016. OEM and the LPC reviewed the mitigation strategy from the 2010 Plan, and provided a status update on the mitigation actions identified in that plan (see Section 6.3). The 2016 Plan goals and objectives are:

Goal
Reduce or eliminate the exposure to property damage, injury or loss of life, and damage to the natural environment caused by hazards.

Objectives	
A	Identify and initiate improvements to public safety, response, and recovery programs to reduce risk and vulnerability.
B	Follow through with and leverage existing organizations, programs, and procedures to implement the HMP.
C	Build upon existing public outreach efforts to reduce risk and vulnerability to hazards.
D	Leverage financial assistance and other resources to strengthen the City's disaster resiliency.
E	Continue to improve the regulatory review process for development and construction in the vicinity of known hazard areas.
F	Continue to assess ongoing disaster preparedness programs that maintain or improve City preparedness.

The LPC and stakeholders identified and prioritized mitigation actions to address the key findings of the risk assessment and achieve the 2016 goals and objectives and to support the purpose of this planning process. The mitigation actions are summarized in the following table and organized by hazard.

Action #	Mitigation Action Name and Brief Description	Objective	Responsible Agency
Wildfire Actions			
W1	**Wildland-Urban Interface (WUI) action** - Formally define the WUI as a different polygon than the Hillside overlay. Make this distinction clear in the locally adopted codes and information materials.	A, C and E	Division of the Fire Marshal (FM)
W2	**Wildfire Mitigation Education and Outreach to Neighborhoods at Risk** - Continue conducting wildfire presentations to neighborhoods in order to educate them on mitigation concepts. One consideration for project prioritization is based on the receptiveness of the community.	B, C and F	Division of the FM
W3	**Wildfire Mitigation Fuel Reduction Activities -** Continue fuels reduction activities to include neighborhood chipping, creating defensible around homes using residential stipends, prescribed burning in remote areas, and hazard fuel reduction projects in common areas and open spaces.	A and D	Division of the FM
W4	**Wildfire Mitigation Outreach to the Business Community** - Expand Business Education and Outreach about wildfire concerns, evacuation, and business continuity. Continue integration with the Division of the Fire Marshal's current efforts focused on businesses and healthcare facilities. Explore expanding outreach to adopt an all-hazards perspective in partnership with OEM.	B and C	Division of the FM/ OEM
W5	**Enhance WHINFOE Risk Model** - Enhance the Wildfire Hazard Information Extraction (WHINFOE) risk model to include adjacency of structures and urban conflagration potential.	A, B, C and E	Division of the FM/ Colorado Springs Information Technology (IT) Department
Flood and Dam/Levee Failure Actions			
F1	**Templeton Gap Floodway Accreditation** - Obtain documentation regarding the floodway's accreditation status from the U.S. Army Corps of Engineers (USACE) and FEMA. Determine if the City should seek accreditation.	A and E	City Public Works/ Stormwater
F2	**Assess Flood Risk for Critical Populations** - Assess the risk for facilities with critical populations (schools, nursing homes, etc.). Consider the need for site-specific EAPs for locations.	A, B and D	City Planning/ Pikes Peak Regional Building Department
F3	**Educate Critical Populations of Flood Risk** - Educate critical populations (schools, nursing homes) of their flood risk and the need to take safety measures. Second step is to assess the risk for critical facilities.	C and F	OEM/ Fire Department Public Information Office (PIO)/ City Communications
F4	**Address Erosion and Sloughing on Stream Banks** - Evaluate additional feasible and functional ways to reduce or eliminate erosion and sloughing on stream banks. Include long-term maintenance considerations in the evaluation.	A, B and D	Public Works/ Stormwater
F5	**Mitigation on Non-Burn Scar Streams** - Implement mitigation actions on non-burn scar streams including in-channel improvements for stability, detention, and zero run-off increase from new development.	A, B and D	Public Works/ Stormwater
F6	**Emergency Action Plans for Streams in Monument Creek Watershed** - Monument Creek is the downstream receiving water for many dams where a failure could affect Colorado Springs. Verify that Emergency Action Plans (EAPs) are available for all higher risk upstream dams.	A, B and C	Colorado Springs Utilities (CSU)/ OEM/ City Parks and Recreation

Action #	Mitigation Action Name and Brief Description	Objective	Responsible Agency
F7	**Evaluation of Enhancements and Enforcement of the Flood Ordinance** - Evaluate the potential of implementing code and/or regulations revisions to further limit or eliminate development in the 100-year floodplain. Enforce current code.	B and E	Planning/ Public Works/ Pikes Peak Regional Building Department
F8	**Drainage Criteria Manual Update** - Consider updating the Drainage Criteria Manual to provide specific guidelines for accommodating long-term maintenance (access, etc.) in the design requirements for storage (sediment catchment and stormwater detention) basins. Update the City of Colorado Springs Drainage Criteria Manual, Volume 1 & Volume 2, to provide for Sustainable and Resilient Stormwater.	A and E	Public Works
F9	**Public Awareness and Messaging about Dams -** Implement public awareness campaign about dams which includes: develop a public relations plan to increase public awareness about the dams in Colorado Springs, develop Public Safety messages for Dam Failure; and target the spring time (2016) in preparation for the monsoon season.	A and C	OEM/ CSU/ City Parks and Recreation
F10	**Gauge-Adjusted Radar Rainfall System -** Re-evaluate the cost/benefit of integrating the available rain gauges with the Gauge-Adjusted Radar Rainfall (GARR) System. Re-evaluate the feasibility and cost/benefit of improving the reporting speed of rain gauges already in place.	A and B	OEM
F11	**Property Acquisition –** Coordinate the acquisition of eligible properties with property owners and State/Federal programs.	D and E	Public Works, OEM, Parks and Recreation, Real Estate Services, Planning
Severe Weather Actions			
SW1	**Burial of Utilities** - Continue to bury utilities underground as feasible.	A, B and D	CSU
SW2	**Tree Trimming and Vegetation Management -** Continue to trim trees and vegetation along power line corridors and infrastructure. Evaluate whether the City can support vegetation trimming via cost-sharing methods.	A, B and D	CSU/City Forestry/ Parks and Recreation
SW3	**Severe Weather Public Outreach and Education** - Provide more information and outreach to the public on hazardous weather risks and mitigation actions so they can better protect themselves and property.	C	City Communications/ National Weather Service (NWS)
SW4	**Evaluate Need for Severe Weather Protection in Building Codes -** Influence building codes to mitigate for severe weather. Evaluate whether certain roof types could be required to mitigate the impacts of hail and damaging winds.	C and E	Pikes Peak Regional Building Department
SW5	**Public Messaging to Avoid Hazardous Areas -** Purchase variable message signs for use at key locations to warn motorists of ice so they can avoid hazardous areas.	C	City Streets
SW6	**Evaluate Need to Modify Building Codes for Drought/Water Conservation -** Review building codes to encourage xeriscape landscapes.	C and E	CSU
Geologic Hazard Actions			
G1	**Landslide Monitoring -** The City should proactively monitor landslides with GPS or pendulum technology.	A and C	City Building Department/ OEM

Action #	Mitigation Action Name and Brief Description	Objective	Responsible Agency
G2	**Earthquake Outreach and Education** - Provide outreach to the public on earthquake risk and mitigation actions they can take to protect themselves and their property.	B and C	OEM
G3	**Landslide Building Codes** – Evaluate the need to modify building codes for landslide susceptible locations within the City's limits. Modify and enforce landslide mitigation requirements and work to ensure against building in areas identified as at-risk to landslides.	A and E	City Planning Department/Pikes Peak Regional Building Department
G4	**Property Acquisition –** Coordinate the acquisition of eligible properties with property owners and State/Federal programs.	D and E	Public Works, OEM, Parks and Recreation, Real Estate Services, Planning.
Human-Caused Hazard Actions			
H1	**Terrorism Public Awareness** - Continue Public Awareness on terrorism risk: o Promote public awareness campaign of shared responsibility and how the public should notify law enforcement of suspicious behavior ("See something, Say something") o Sustain capability to use Integrated Public Alert and Warning System (IPAWS) o Continue support of Civil-Military Emergency Management Collaborative	B and C	CSPD/ Communications/ PIO/ OEM
H2	**Collaboration to Address Terrorism Risk** - Enhance collaboration and coordination among Law Enforcement, Emergency Management and other intelligence-gathering agencies to address terrorism threats. o Increase participation in monthly Regional Threat Working Group meetings with CIAC which are focused on terrorist/criminal threat. CSU also has a monthly meeting. o Coordinate with Colorado Division of Homeland Security and Emergency Management (DHSEM) security representative.	A, B and C	CSPD/DHSEM/ CIAC/CSU
H3	**Hazardous Materials Readiness and Warning Capabilities** - Continue improving readiness and warning to appropriate officials and public for potential HAZMAT incidents for public safety and to reduce secondary impacts o Sustain capability of using IPAWS for public warning o Continue to plan HAZMAT exercises o Prepare pre-scripted messages for IPAWS o Consider ways to quickly inform public. Work with media.	A, C, D and F	OEM/CSPD Communications/ CSFD
H4	**Sustain Tier II Reporting** - Sustain Tier II facility reporting using the Hazardous Materials Management and Emergency Reporting System (HAMMERS).	A, B and F	LEPC/CSFD
H5	**Coordination with Railroad on Hazardous Materials Incidents** - Continue to coordinate with the railroad industry to improve collaboration and response in case of large HAZMAT incident.	A, B, C and F	OEM/CSFD

Action #	Mitigation Action Name and Brief Description	Objective	Responsible Agency
H6	**Enhance Public Education on Infectious Disease** - Continue public education for infectious disease on several topics including vaccinations, emerging diseases, and things to avoid (e.g., animal carcasses). Raise awareness of El Paso County Health Department's website.	A, B, C and F	El Paso County Public Health (EPCPH)/ Colorado Department of Public Health and Environment (CDPHE)
H7	**Evaluate Infectious Disease Response Operations** - Review response operations to intervene and stop the spread of infectious disease o Maintain awareness of infectious disease response roles and responsibilities o Maintain a strong relationship with EPCPH o Participate in Public Health Exercises o Educate public on what would happen if they were quarantined and resources that can support them during it o Conduct an exercise for setting up Point of Dispensing locations	A and F	EPCPH/OEM/ CDPHE/CSPD/ El Paso County Sheriff's Office/El Paso County OEM
H8	**Cyber Threat Education and Awareness** - Implement education and awareness activities for City of Colorado Springs employees to reduce cyber threats and hacking via phishing attacks. Formalize training program and Tabletop Cyber Scenarios.	C and F	IT/OEM
H9	**Continuity of Operations -** Evaluate Continuity of Operations scenarios if technology is incapacitated (e.g., no phones, no computer) o Use of 800 megahertz, VHF, and ham radios, hardline phones, and courier services o Conduct exercises o Explore contracting with mobile companies that can help restore functionality to internet o Mobile telephone companies will provide some cellular service free of charge during an emergency	A, B and F	OEM IT/OEM/ CSPD/CSFD/ Contracting

There were 29 mitigation actions developed in the 2010 Plan, and progress was made on each one. Some of these are carried forward into the 2016 Plan. This plan contains 35 mitigation actions. The City of Colorado Springs Plan has been adopted by the City Council and will be maintained and updated according to the plan maintenance structure summarized in Chapter 7. This Plan will be updated again within the next five years to maintain eligibility for the FEMA mitigation grant programs.

1. Introduction to Mitigation Planning

This chapter provides information on the purpose and participating jurisdictions in the City of Colorado Springs Hazard Mitigation Plan (HMP or Plan), describes federal hazard mitigation planning requirements and grant programs, and lists an outline of the Plan's organization. The 2016 Plan updates the 2010 and 2005 Hazard Mitigation Plans for Colorado Springs, Colorado (formerly called the Pre-Disaster Mitigation Plans or PDMP and referred to as the 2005 or 2010 Plan).

1.1 Plan Purpose and Participating Jurisdictions

The City of Colorado Springs prepared this local HMP to better protect the people and property within the City's jurisdiction from the impacts of natural hazard events. The 2005 and 2010 plans were single-jurisdiction plans. As part of the plan update process, the City Office of Emergency Management (OEM) determined that the plan would remain a single-jurisdictional plan.

Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." Mitigation creates safer communities by reducing loss of life and property damage. Hazard mitigation planning is the process through which hazards that threaten communities are identified and profiled, likely impacts of those hazards are assessed, and mitigation strategies to lessen those impacts are identified, prioritized, and implemented. The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of $4 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council, 2005).

This plan demonstrates the City of Colorado Springs' commitment to reducing risks from hazards and serves as a tool to help decision makers direct and coordinate mitigation activities and resources, including local land use policies. In the aftermath of the Waldo Canyon Fire and subsequent flooding events, the City has been proactive in establishing sediment control basins to reduce the impacts of flooding, erosion and sedimentation. These efforts have been tested several times as of July 2015 and have been successful.

1.2 Mitigation Planning Requirements

The Federal Disaster Mitigation Act of 2000 (DMA 2000) passed by Congress includes a mitigation planning section (322). This section emphasizes the need for state, tribal, and local entities to coordinate mitigation planning and implementation efforts. In addition, it provides the legal basis for FEMA's mitigation plan requirements for mitigation grant assistance.

To implement these planning requirements, FEMA published an Interim Final Rule in the *Federal Register* on February 26, 2002 (FEMA 2002a), 44 CFR Part 201 with subsequent updates. The planning requirements for local entities are identified in their

appropriate sections throughout this plan. FEMA's October 31, 2007 changes to 44 CFR Part 201 combined and expanded flood mitigation planning requirements with local mitigation plans (44 CFR §201.6). It also required participating National Flood Insurance Program (NFIP) communities' risk assessments and mitigation strategies to identify and address properties repetitively damaged by flood. Appendix A includes a completed FEMA plan review tool, which is an official report card used by FEMA reviewers for local hazard mitigation plans documenting compliance with 44 CFR§201.6.

Community Rating System (CRS)

In addition to FEMA requirements, the City of Colorado Springs also participates in the CRS program. During the preparation of the 2010 Plan, Colorado Springs was CRS Class 8. By the time the 2016 Plan process started, Colorado Springs had improved to Class 6. The next CRS Cycle Verification will occur in 2019. As the City continues to improve its programs and processes, it may choose to apply for a modification of its CRS classification once per year. Alternatively, the City may document the improvements at the next Cycle Verification visit.

Emergency Management Accreditation Program (EMAP)

In addition to FEMA requirements, the City of Colorado Springs also maintains certification through the EMAP by complying with the updated 2013 Emergency Management Standards set forth by the EMAP program. The following EMAP Standards are addressed through this Plan:

4.3 Hazard Identification, Risk Assessment and Consequence Analysis
4.4 Hazard Mitigation

Specific requirements for these EMAP Standards are identified in Chapter 4. Risk Assessment, Chapter 6. Mitigation Strategy, and Chapter 7. Plan Maintenance.

1.3 Grant Programs Requiring Hazard Mitigation Plans

Local hazard mitigation plans qualify communities for the following federal mitigation grant programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

The HMGP and PDM grant programs are authorized under the Stafford Act and DMA 2000, while the FMA, Severe Repetitive Loss (SRL), and Repetitive Flood Claims (RFC) grant programs are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. The HMGP is a state competitive grant program for communities in areas covered by a recent disaster declaration that allows those communities to apply for funds. The PDM, FMA, RFC, and SRL programs are also competitive but are available on an annual basis and do not require a disaster declaration; they rely on specific pre-disaster grant funding sources.

In 2008, FEMA combined the PDM program with the FMA, RFC, and SRL programs into a unified Hazard Mitigation Assistance (HMA) program application cycle. In 2009, HMGP was added to the HMA guidance. The intent of this alignment is to enhance the quality and efficiency of grant awards on an allocation and competitive basis to state and local entities for worthwhile, cost-

beneficial activities designed to reduce the risks of future damage in hazard-prone areas. In 2013, the RFC and SRL were eliminated and elements of these flood grant programs were incorporated into the FMA program.

Disaster Funded Mitigation Assistance

Hazard Mitigation Grant Program: Provides grants to states, tribes, and local entities to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Projects must provide a long-term solution to a problem, for example, elevation of a home to reduce the risk of flood damage as opposed to purchasing supplies to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a disaster declaration is limited. The program may provide a state or tribe with up to 20% (with an approved Enhanced State Mitigation Plan) of the total disaster grants awarded by FEMA. The cost-share eligibility requirement for this grant is 75% Federal/25% non-Federal.

Hazard Mitigation Assistance Programs

Pre-Disaster Mitigation Program: Provides funds to states, tribes, and local entities, including public universities, for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Grants are awarded on a nationally competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The cost-share eligibility requirement for this grant is 75% Federal/25% non-Federal. There has been approximately $30 million available from 2011 to 2015 which was less than the $50 to $150 million available annually from 2005 to 2010. Communities compete nationally for the funds although the state is guaranteed $500,000 in project dollars. It is expected that at least one Colorado community will receive money; assuming approvable grant applications are received.

Flood Mitigation Assistance Grant Program: The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the NFIP. Particular emphasis for this program is placed on mitigating repetitive loss properties. Two other related pre-disaster programs, the SRL and RFC programs are now more recently part of the FMA. Repetitive loss (RL) properties are properties for which two or more NFIP losses of at least $1,000 each have been paid within any 10-year period since 1978. A SRL property is one for which four or more separate claims payments have been made under flood insurance coverage, with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or one that for which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Funding is available for three types of grants, including planning, project, and technical assistance. Project grants, which use the majority of the program's total funding, are awarded to states, tribes, and local entities for planning and technical assistance and/or to apply mitigation measures to reduce flood losses to properties insured under the NFIP. The cost-share eligibility requirement for this grant is 75% Federal/25% non-Federal unless there are SRL or RL properties involved. FMA projects with SRL properties can receive a 100% Federal cost share, while FEMA projects with RL properties can receive a 90% federal cost share. To be eligible for a higher federal cost share for FMA projects with SRL/RL properties, a FEMA-approved state HMP that includes a RL Strategy must be in effect at the time of grant award. In Colorado there is approximately $100,000-

$150,000 available annually state-wide. Communities must first compete state-wide and then nationally, if there is money left over in the system.

1.4 Plan Organization

The City of Colorado Springs 2016 HMP is organized as follows:

- **Adoption** includes the City's resolution of adoption for the plan.
- **Chapter 1: Introduction to Mitigation Planning** describes the plan's purpose, hazard mitigation planning requirements, and federal hazard mitigation grant programs.
- **Chapter 2: Community Profile** provides a general description of the City of Colorado Springs, including its location, geography, climate, history, population, economy, and government.
- **Chapter 3: Planning Process** describes the planning process used to develop this Plan, including how it was prepared, who was involved in the process, and how the public was involved.
- **Chapter 4: Risk Assessment** identifies and profiles the hazards that could affect the city and assesses vulnerability to those hazards. It provides an inventory of critical facilities and other community assets in the city, and describes land use and development trends. It includes how hazards may be impacted by climate change and describes secondary impacts caused by hazards.
- **Chapter 5: Capability Assessment** of the existing plans, programs, and policies in the city related to mitigation
- **Chapter 6: Mitigation Strategy** identifies goals and actions to mitigate hazards in Colorado Springs based on the results of the risk assessment. The mitigation actions are analyzed and prioritized, including a status update on the mitigation actions identified in the 2010 Plan. This chapter also includes an implementation strategy.
- **Chapter 7: Plan Maintenance** provides a formal process for monitoring, evaluating, and updating the plan; discusses how to incorporate the plan into existing planning mechanisms; and offers plans for continued public involvement.
- **Appendix A: Plan Review Tool** includes a completed FEMA Local Mitigation Plan Review Tool documenting compliance with 44 CFR§201.6.
- **Appendix B: Planning Process Documentation** compiles agendas, sign-in sheets, website announcements, survey results, and other materials documenting the planning process. It also includes the worksheets used by the LPC and Stakeholders to identify, refine, evaluate and prioritize mitigation actions.
- **Appendix C: Hazards and Mitigation PowerPoint** presented at the July 29, 2015 Risk Assessment meeting summarizing many of the City's flood/fire recovery and mitigation actions since 2012.
- **Appendix D: Plan Maintenance Forms** provides a mitigation action progress reporting form and an annual plan review questionnaire to assist in evaluating and maintaining the plan as described in Chapter 7: Plan Maintenance.
- **Appendix E: Flood Hazard Modeling Results** includes the modeling results for flood hazards in the City of Colorado Springs. This includes mapping tiles for each identified floodplain for the 2-, 10-, 100-, and 500-year flood events.
- **Appendix F: References** provides references for information sources cited in the plan (in addition to those listed in the footnotes and citations throughout the plan).

2. Community Profile

This section describes the location, geography, climate, history, population, economy, and government of the City of Colorado Springs.

2.1 Location, Geography, and Climate

Location

The City of Colorado Springs is located in south-central Colorado between the foothills of the Rocky Mountains and the eastern plains of Colorado. Colorado Springs is approximately 60 miles south of Denver, in El Paso County. The location of Colorado Springs is illustrated in Figure 2-1.

Geography

The City of Colorado Springs's geography is characterized by the transition between Colorado's western mountainous terrain and the rolling topography of the eastern plains. Portions of the western half of the City exist within the steep slopes abutting the Pike National Forest. The eastern half of the city consists of developed and vacant land on the typical grasslands and buttes of the Colorado plains.

Climate

Like much of the Colorado Front Range, Colorado Springs enjoys a mild climate, accompanied by an average of 127 full sun days per year (not including partly sunny or partly cloudy days, of which there are reported to be more than 300 "sunny days"). Average snowfall in the City of Colorado Springs is approximately 39 inches per year. Although snowstorms are fairly common in the City, the intensity of the Rocky Mountain sunshine typically melts the snow and ice quickly from the streets. The warmest month in Colorado Springs is July, with an average high temperature of 85.0 degrees. The coldest month is January, with an average high temperature of 42.6 degrees, and an average low temperature of 16.6 degrees. Colorado Springs receives approximately 15.7 inches of precipitation per year on average. The highest precipitation is during the month of July, with 2.92 inches on average.[1]

With a better understanding of the implications of climate change, the 2014 U.S. National Climate Assessment (NCA) has been reviewed for relevance to hazards in Colorado Springs. In summary, climate change will exacerbate the impacts of several hazards that are present in Colorado Springs. In Chapter 4 (Risk Assessment), the impacts on these individual hazards are described. Below is the NCA's overall assessment of climate change on the Southwest, which includes Colorado:

- Snowpack and streamflow amounts are projected to decline in parts of the Southwest, decreasing surface water supply reliability for cities, agriculture, and ecosystems.

[1] Source: Western Regional Climate Center, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co1778, accessed June 14, 2015

- The Southwest produces more than half of the nation's high-value specialty crops, which are irrigation-dependent and particularly vulnerable to extremes of moisture, cold, and heat. Reduced yields from increasing temperatures and increasing competition for scarce water supplies will displace jobs in some rural communities.
- Increased warming, drought, and insect outbreaks, all caused by or linked to climate change, have increased wildfires and impacts to people and ecosystems in the Southwest. Fire models project more wildfire and increased risks to communities across extensive areas.
- Projected regional temperature increases, combined with the way cities amplify heat, will pose increased threats and costs to public health in southwestern cities, which are home to more than 90% of the region's population. Disruptions to urban electricity and water supplies will exacerbate these health problems.[2]

Major natural hazards like drought, wildfires, flood, thunderstorms, and severe winter storms will increase in intensity due to climate change. It will also have effects on infectious disease as increased temperatures may facilitate the spread of diseases more typically associated with a warmer climate.

[2] P.463 of the 2014 National Climatic Assessment, http://nca2014.globalchange.gov/, accessed June 2015

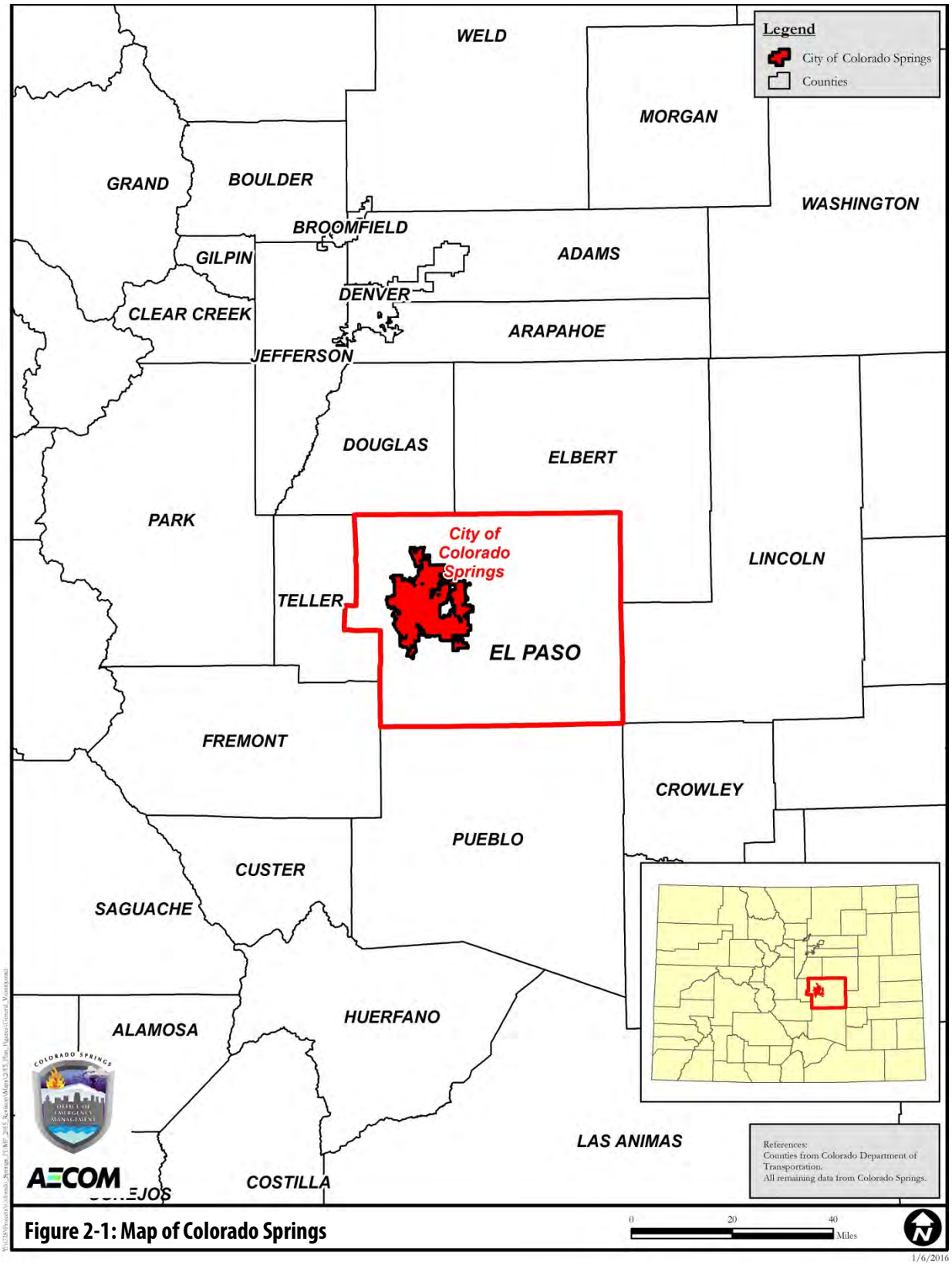


Figure 2-1: Map of Colorado Springs

2.2 History

Approximately 15,000 years ago, the first Native Americans may have appeared in Colorado. The earliest inhabitants were hunters and nomadic foragers on the plains, as well as the western plateau. Agricultural settlements began appearing along river valleys in the eastern part of Colorado from approximately 5,000 B.C. as people learned farming techniques from the Mississippi River Native Americans.

The first Europeans to venture into Colorado were the Spanish. In 1540-41, Coronado led an expedition north from Mexico in search of the Seven Cities of Cibola where the streets were allegedly paved with gold. Although this exact route is unknown, it is likely Coronado and his party passed through the present-day area of southeastern Colorado. Over the next 250 years, the Spanish made other expeditions into the Colorado area.

In 1800, Spain ceded a vast area, including Colorado, to Napoleon Bonaparte and the French. Three years later, the same parcel of land was sold by Napoleon to the United States as the "Louisiana Purchase." In 1806, President Jefferson commissioned Lieutenant Zebulon Pike to explore the recently purchased territory. Among the sites mentioned by Pike in his report of the expedition was the 14,110-foot peak which today bears his name.

Originally called Fountain Colony, Colorado Springs was founded in 1871 by General William Jackson Palmer. His vision for this new city of Colorado Springs was one of culture, beauty, and a good quality of life at the foot of Pikes Peak. Colorado Springs became especially popular with the British and acquired the nickname Little London. Riding the rails, visitors came to see the area's beauty and were inspired to stay by a mild climate and the region's growing resort accommodations.

In 1861, a bill to create Colorado Territory was passed and President Lincoln appointed William Gilpin as the state's first territorial governor. The population of Colorado in 1861 was 21,000. The first legislature, sitting in Denver, selected Colorado City (west of present day Colorado Springs) as the capitol. The second legislature met there only a few days, in 1862, and adjourned to Denver. The assembly met in Denver and Golden up to 1867 when Denver was named the permanent seat of the territory. In 1876 - fifteen years after becoming a territory - Colorado was admitted as the thirty-eighth state in the union. Colorado was called the "Centennial State" in honor of the one-hundredth year of the Declaration of Independence. In the 1890s, Colorado Springs found it was surrounded by more than scenic wealth. Historians estimate that approximately 50,000 people came to Colorado in search of gold in 1858-59.

Gold was discovered in nearby Cripple Creek in 1891, and Colorado Springs became a thriving financial center. The gold rush had a dramatic effect on Colorado Springs. Miners became millionaires, mansions were built and fortunes were spent all to the betterment of Colorado Springs. General Palmer's wisdom and planning along with the gold from Cripple Creek gave this beautiful city a wonderful legacy and many invaluable gifts. The City benefited in the form of office buildings, mansions, luxury hotels, parks and recreation, and a reputation of being a city of healthful and gracious living.

The golden years lasted until 1917, when the U.S. went to silver for its coinage and the local economy once again emphasized tourism. Looking to expand its economic base, the City offered land to the military in 1942. With the start of World War II, Fort Carson was established on 137,000 acres to the south of Colorado Springs. The military's presence grew in the 1950s with the opening of the U.S. Air Force Academy. Over the next 30 years, Peterson Air Force Base, Cheyenne Mountain Air Force Station and Schriever Air Force Base helped create Colorado Springs' reputation as the nation's military space capital, housing the North American Aerospace Defense Command (NORAD), and other Space Command centers. Since September 11, 2001, U.S. Northern Command (NORTHCOM) has been activated and located in Colorado Springs.

Manufacturing expanded tremendously when the area's quality of life and cost advantages were recognized in the 1960s and 1970s. Today, computers, electronic equipment, semiconductors, precision parts, plastics, equipment and countless other high-quality products are manufactured in the Pikes Peak region and shipped to national and international markets. The amateur sports segment is one of several service industries expanding in the region. Colorado Springs is home to the headquarters of the U.S. Olympic Committee and Olympic Training Center, the world's finest multi-sport training facility. Many other national nonprofit organizations have moved their headquarters to the Pikes Peak region.

Downtown Colorado Springs has experienced a revival, and a vibrant mixture of small business, parks, street art, professionals, and students creates a diverse and comfortable atmosphere. Colorado Springs has experienced dramatic changes in its history. Now military bases, high-tech companies, higher education facilities, and a thriving community of small businesses offer many opportunities here on the edge of the Rocky Mountains.[3]

2.3 Population

Colorado Springs is the second largest municipality in the State of Colorado with an estimated population of 445,830 in 2014, according to the most recent U.S. Census update available during plan preparation. Table 2-1 provides official population data for Colorado Springs and the State of Colorado from the 2000 and 2010 U.S. Census along with the 2014 estimate. From 2000 to 2014, Colorado Springs percent population change is almost the same as the state.

El Paso County, in which Colorado Springs resides, is expected to surpass Denver County in terms of population by the year 2040. El Paso County's projected population in 2040 is estimated at 955,871 and Denver County's at 857,074. The Denver Metropolitan Statistical Area (MSA) is still expected to be much larger than the Colorado Springs MSA in year 2040.[4]

Table 2-1: City of Colorado Springs Population

Area	2000 (census)	2010 (census)	2014 (estimated)	Percent Change from 2000 to 2014
City of Colorado Springs	360,890	416,427	445,830	23.5%
Colorado	4,301,261	5,029,196	5,355,866	24.5%

Source: U.S. Census Bureau Quick Facts, 2015.

2.4 Economy

From the 2010 Plan through this Plan in 2016, the economies of Colorado and Colorado Springs have significantly improved since the Great Recession that started in 2008. The 2015 Colorado Business Economic Outlook described the state of the Colorado economy:

> *Colorado continued to post faster economic growth than the nation in 2013. Colorado ranked sixth in real GDP growth, behind North Dakota, Wyoming, West Virginia, Oklahoma, and Idaho. Colorado ranked fourth in*

[3] Mitigation Plan for Colorado Springs, Colorado, March 2005.

[4] Colorado Department of Local Affairs, State Demography Office, online at http://www.colorado.gov/cs/Satellite?c=Page&childpagename=DOLA-Main%2FCBONLayout&cid=1251593346834&pagename=CBONWrapper , accessed on June 10, 2015.

employment growth, behind only North Dakota, Utah, and California. The notion of an outperforming economy is not new to the state—even viewing longer term growth statistics, Colorado tends to be above the median for growth in GDP, employment, population, and the labor force. However, while per capita personal income and average annual pay remain above the national average, the growth in per capita personal income and the growth in average annual pay are lagging the nation.

Among other accolades, Colorado boasts the second highest rate of bachelor's degrees according to Census data, Entrepreneur listed Colorado as the second-best place to start a business in 2013, and the U.S. Chamber of Commerce ranked Colorado second in its Innovation and Entrepreneurship Index.

The state is measurably outperforming due to the talented workforce, key infrastructure, diverse industries, and the aggressive efforts by state and local economic development. The Colorado Office of Economic Development and International Trade rolled out the Colorado Blueprint, which focuses on a bottom-up approach to economic development, with attention paid to business retention and acquisition, as well as key industry clusters ranging from aerospace to information.[5]

Locally, the seasonally adjusted unemployment rate for El Paso County for March 2015 was 4.8%. It continues the downward trend taking place since the unemployment rate peaked at 10.6% in 2010. By comparison, the seasonally adjusted unemployment rate in Colorado was 4.2% in March 2015, down from 9.1% in 2010.

From 2006 to the third quarter of 2014, the largest increase in employment has been in the health and social services sector, which is true for the rest of the country. Increases have also occurred in accommodations and food services, education and professional/technical services. The largest declines have been seen in manufacturing and the finance and insurance sectors. [6] The number of permits issued for single-family and multi-family housing has increased from a 15-year low in 2009 of just over 1,000 issued; whereas, in 2015 it is projected to be over 3,000. Likewise, home sales hit a 15-year low in 2010 of 8,185, and in 2015 are projected to be over 11,000[7].

The largest major industry sector was the health care and social assistance industry, with more than 36,000 employees. Second to health care was the retail trade industry, with over 33,000 employees.[8]

Table 2-2 shows a list of major industries in Colorado Springs for the fourth quarter of 2008. The unemployment rate in April 2015 for the Colorado Springs MSA was 5.2%, compared to the national unemployment rate of 5.1%.[9]

[5] Colorado Business Economic Outlook 2015, CU Leeds School of Business, https://www.colorado.edu/leeds/sites/default/files/attached-files/2015%20Colorado%20Business%20Economic%20Outlook.pdf, accessed June 14, 2015

[6] UCCS Quarterly Economic Update, May 2015, file:///E:/Colorado%20Springs%20HMP/QUE0515.pdf, accessed June 15, 2015

[7] From Southern Colorado Economic Forum, at http://www.southerncoloradoeconomicforum.com/publications/SCEF-Presentation-Oct-10-2014-Final.pdf, accessed June 28 2015

[8] https://www.colorado.gov/pacific/cdle/labor-statistics, Accessed June 2015

[9] http://www.coloradospringsbusinessalliance.com/library/City_Comparisons/Unemployment_Rates.pdf, Accessed June 2015

Table 2-2: Industry Distribution for the Colorado Springs MSA

Industry	Establishments	Employees
Health Care and Social Assistance	1,924	36,293
Retail Trade (44 & 45)	1,917	33,012
Accommodation and Food Services	1,338	28,553
Education Services	387	27,604
Professional, Scientific & Technical Svc	3,420	22,794
Admin., Support, Waste Mgmt, Remediation	1,181	18,048
Construction	1,765	14,037
Public Administration	104	13,407
Manufacturing (31-33)	523	12,009
Finance and Insurance	1,059	11,789
Other Services (except Public Admin.)	1,404	10,130
Information	315	7,417
Arts, Entertainment, and Recreation	298	5,276
Transportation and Warehousing (48 & 49)	329	5066
Wholesale Trade	810	5,051
Real Estate and Rental and Leasing	1,095	4,252
Utilities	40	2,484
Management of Companies and Enterprises	149	1,137
Agriculture, Forestry, Fishing & Hunting	44	254
Unclassified establishments	Unavailable	Unavailable

Source: Colorado Dept. of Labor, 2014.

2.5 Government

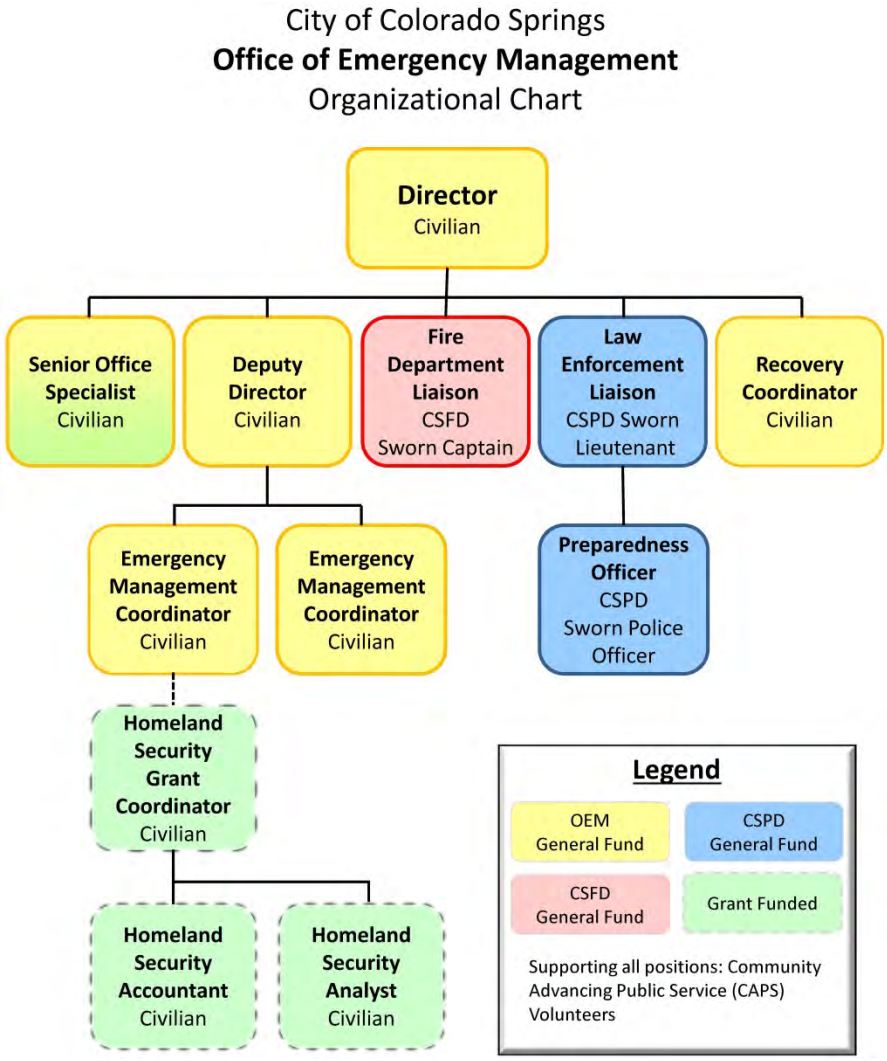
The City of Colorado Springs incorporated on June 19, 1886. Colorado Springs is a home rule municipality meaning that it is self-governing under State Constitution, Colorado Revised Statutes, and the Home Rule Charter for Colorado Springs. The City operates as a mayor-council form of government. The City Council appoints several city officials including the City Auditor, Executive Director of Colorado Springs Utilities (CSU), and the City Council Administrator. Most of the city government is within the leadership of the City Manager, organized into departments or divisions, and led by directors. The City has 34 departments or agencies including:

- Airport
- Budget
- Business Climate
- City Attorney
- City Auditor
- City Clerk
- Finance
- Fire
- Forestry
- Human Resources
- Information Technology
- Land Use Review
- Planning and Development
- Police
- Procurement Services
- Public Works
- Real Estate Services
- Sales Tax

- City Council
- Communications
- Community Development
- City Engineering
- Economic Vitality
- Engineering Development Review
- Mayor's Office
- Municipal Court
- Office of Emergency Management
- Parking System Enterprise
- Parks, Recreation, and Cultural Services
- Special Events
- Stormwater
- Streets
- Traffic Engineering
- Transit (Metro Mountain Transit)

OEM, which is now its own department, is structured as shown in Figure 2-2.

Figure 2-2: Colorado Springs Office of Emergency Management Organization



Source: Colorado Springs Office of Emergency Management, 2014 Annual Report.

Although there are several references to El Paso County (when data was only available at the county level), this Plan only applies to the City of Colorado Springs, and is administered by OEM.

3. Planning Process

This chapter describes the planning process used to develop the 2016 Plan, including how it was prepared, who was involved in the process, and how the public was involved.

3.1 Hazard Mitigation Local Planning Committee

City of Colorado Springs contracted with AECOM Technical Services, Inc. (AECOM), formerly URS Corporation, in May 2015 to assist in updating their hazard mitigation plan by facilitating the hazard mitigation planning process and developing the plan document. The City of Colorado Springs OEM and AECOM worked together to convene the LPC to guide the planning process and make key decisions. An invite list for the LPC is included in Appendix B: Planning Process Documentation. The agencies that participated in the LPC are listed in Table 3-1.

In the planning process for the 2016 update, the LPC reviewed and updated each of the sections of the previously approved 2010 Plan, including improving organization and formatting and adding substantially more in-depth information specific to the City of Colorado Springs. For example, the 2010 Plan included some basic human-caused hazard information in Appendix E. This information has been greatly expanded and is now included as a hazard in Section 4.

The process for updating each section is described in the planning process steps in Section 3.2, as well as in each relevant plan chapter. The plan update preparation process was similar to that of the 2010 Plan in that the city formed a team, included the public and state and federal agencies, pulled information from other sources and stakeholders, and reviewed drafts of the document to help inform the overall plan update. For the 2016 Plan, the stakeholders were involved in each step of the process including all three meetings. This Plan built upon the progress of the 2010 process.

Table 3-1: Local Planning Committee Participants

Agencies and Representatives that participated on the Colorado Springs LPC:	
Bret Waters	Colorado Springs Office of Emergency Management
Bart Howard	Colorado Springs Office of Emergency Management
Tobi Blanchard	Colorado Springs Office of Emergency Management
Gordon Brenner	Colorado Springs Office of Emergency Management
David Vitwar	Colorado Springs Fire Department
David Edmonson	Colorado Springs Police Department
Ryan Tefertiller	Colorado Springs Planning – Land Use Review
Peter Wysocki	Colorado Springs Planning – Land Use Review
Travis Easton	Colorado Springs Engineering
Tim Mitros	Colorado Springs Engineering
Steve Vigil	Colorado Springs Information Technology – Geographic Information Systems
Steve Kuhr	Colorado Springs Utilities

Agencies and Representatives that participated on the Colorado Springs LPC:	
Deb Griffin-Strickland	Colorado Springs Utilities
Ken Hughlett	Colorado Springs Utilities
Keith Curtis	Pikes Peak Regional Building Department
Brian Kelley	Colorado Springs Public Works
Tom Gonzales	El Paso County Public Health
Patricia Gavelda	Colorado Division of Homeland Security and Emergency Management – Mitigation and Recovery
Paul Eller	Colorado Division of Homeland Security and Emergency Management – South Central Regional Field Manager

To ensure participation in the plan development, LPC members were asked to complete the following:

- Attend and participate in meetings
- Complete baseline and detailed surveys to provide input on key mitigation topics
- Collect risk assessment data
- Provide status of 2010 Plan actions
- Provide feedback on plan process and content
- Participate in mitigation strategy brainstorming sessions
- Participate in mitigation action and evaluation sessions
- Coordinate and assist with the public outreach strategy
- Review plan drafts
- Help coordinate the final adoption of the plan

For the 2016 Plan, a stakeholder group was formed that represented key members of the community, as shown in Table 3-2. This group was invited to each meeting. Their representation of a broad cross-section of organizations in the Colorado Springs community and surrounding communities was greatly valued. The stakeholders were also asked to complete many of the same activities as the LPC.

Table 3-2: Stakeholders

Organizations that were Stakeholders in the development of the 2016 Colorado Springs Hazard Mitigation Plan:	
Christopher Korwes	Peterson AFB
Ray Dunn	Fort Carson
Anthony Sevey	Fort Carson
Andre Mouton	United States Air Force Academy
Erik Waldrip	Cheyenne Mountain Air Force Station
James Hannon	USAA
Mike Brady	Federal Express
Tim Mitros	Fountain Creek Watershed Flood Control and Greenway District
Jim Barrentine	Pikes Peak Community College

Organizations that were Stakeholders in the development of the 2016 Colorado Springs Hazard Mitigation Plan:	
Tim Stoecklein	University of Colorado at Colorado Springs
Kenny Quintana	Colorado Department of Transportation
RC Smith	El Paso County OEM
Lizabeth Jordan	El Paso County OEM
Caroline Sasaki	El Paso County OEM
Bart Evans	El Paso County OEM
Mark Boley	El Paso County Sheriff's Office
Nancy Gorsich-Bracken	Black Forest Together, Inc. and South Central Region Voluntary Organizations Active in Disaster
Sally Broomfield	American Red Cross
David Poage	American Red Cross
David Stanton	American Red Cross
Russ Roux	South Central Healthcare Coalition
Tom Magnuson	National Weather Service
Brian Grady	Academy School District 20
James Hastings	Colorado Springs School District 11
David Watson	Falcon School District 49
Tim Burgard	Harrison School District 2
Cindy Corsaro	Memorial Hospital – UCHealth
Brigitte French	Penrose St. Francis
Jeff Force	Memorial Hospital – UCHealth
Jeremy Walker	Colorado Technical University
Oscar Martinez	U.S. Forest Service – Pike and San Isabel National Forest
Cole Platt	Colorado Springs Streets Department

The Colorado Springs 2016 Plan was prepared during the course of six months. Table 3-4 lists the dates and agenda items for the meetings of the Planning Team. Full agendas and sign-in sheets are included in Appendix B: Planning Process Documentation.

3.2 Mitigation Planning Process

FEMA Requirement

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

The LPC used FEMA's planning process integrating recommendations from FEMA's *Local Mitigation Planning Handbook* (2013), the Local Mitigation Plan Review Tool, and the 10-step planning process used for FEMA's CRS program. Table 3-3 shows how

the modified 10-step process corresponds with the planning requirements of the Disaster Mitigation Act and the elements in the Plan Review Tool.

Table 3-3: Planning Process Used to Develop the Plan

Disaster Mitigation Act Requirements 44CFR 201.6 and Local Plan Review Tool	2013 CRS Manual Planning Steps
Element A: Planning Process	
201.6(c)(1)	Step 1: Organize to Prepare the Plan
201.6(b)(1)	Step 2: Involve the Public
201.6(b)(2) and (3)	Step 3: Coordinate (with Other Departments and Agencies)
Element B: Hazard Identification and Risk Assessment	
201.6(c)(2)(i)	Step 4: Assess the Hazard
201.6(c)(2)(ii)	Step 5: Assess the Problem
Element C: Mitigation Strategy	
201.6(c)(3)(i)	Step 6: Set Goals
201.6(c)(3)(ii)	Step 7: Review Possible Activities
201.6(c)(3)(iii)	Step 8: Draft an Action Plan
Elements D and E: Plan Evaluation and Maintenance; and Plan Adoption	
201.6(c)(5)	Step 9: Adopt the Plan
201.6(c)(4)	Step 10: Implement, Evaluate, and Revise the Plan

Source: FEMA Local Mitigation Planning Handbook, 2013 and 2013 CRS Coordinator's Manual

This section provides a narrative description of the planning process.

Element A: Planning Process

Step 1: Organize to Prepare the Plan

The planning process began with a Pre-kickoff Meeting Conference Call on April 15, 2015, and then a Project Kickoff Meeting on May 12. During the Kickoff meeting, AECOM presented information on the scope and purpose of the plan, participation requirements of the LPC and the City of Colorado Springs, and an overview of the planning process and schedule. AECOM and the Colorado Springs OEM discussed ideas for involving the public (Step 2) and coordination with other agencies and departments (Step 3).

LPC and Stakeholders responding to survey during the Kickoff Meeting.

Table 3-4: Colorado Springs Hazard Mitigation Planning Meetings

Date	Meeting Type and Agenda
April 16, 2015	**Pre-kickoff Meeting Conference Call (OEM and AECOM)** • Discussed data needs • Identified members of the LPC and Stakeholders • Discussed date and information to present at Kickoff Meeting • Discussed schedule • Discussed Plans to review
May 12, 2015	**Kickoff Meeting which included both the Local Planning Committee and Stakeholders as representatives of the public** • Presented purpose and overview of mitigation planning and Colorado Springs Plan • Presented purpose and roles of the LPC and Stakeholders • Described Local Mitigation Planning Process including themes and concepts, list of potential hazards, plans to review and review of 2010 Plan goals and actions • Discussed public outreach strategies • Continued discussion of hazard identification and data collection process • Conducted Baseline and Detailed Surveys including presenting results of baseline survey (see Section 4.1 for results)
July 29, 2015	**Risk Assessment Meeting** • Updated the LPC and Stakeholders on plan development status including receipt of updates of 2010 actions from various LPC members • Discussed public outreach survey released on July 27 • Provided an overview of risk assessment update • Briefed by the City's Disaster Recovery Coordinator on the implemented mitigation measures since 2010, including post-flood and wildfire activities • Conducted four brainstorming sessions with all LPC and Stakeholders to review issues resulting from risk assessment and start development of high-level strategies and specific actions for 2016 Plan • Facilitators of brainstorming sessions reported results of sessions for the benefit of and evaluation by the whole group • Reviewed and modified 2010 goals/objectives for 2016 Plan post-meeting
September 10, 2015	**Mitigation Strategy Meeting** • Reviewed results of public survey • Presented final review of risk assessment • Presented refined mitigation goals and objectives along with status of 2010 actions • Evaluated and refined actions originating from July 29 mitigation strategies brainstorming sessions • Prioritized mitigation actions • Discussed schedule for review of draft plan (LPC, stakeholders, and public review)

Step 2: Involve the Public

FEMA Requirement

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process, include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private a non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

EMAP Standards (2013)

Standard 4.4.2: The mitigation program includes participation in applicable jurisdictional, inter-jurisdictional and multi-jurisdictional mitigation efforts.

At the first two meetings, the LPC discussed different options for involving the public in the hazard mitigation planning process and finalized the following outreach plan. This section addresses EMAP Standard 4.4.2 by showing how Colorado Springs participates in multi-jurisdictional efforts such as involvement of El Paso County and Pikes Peak Regional Building Department (PPRBD) in this planning process.

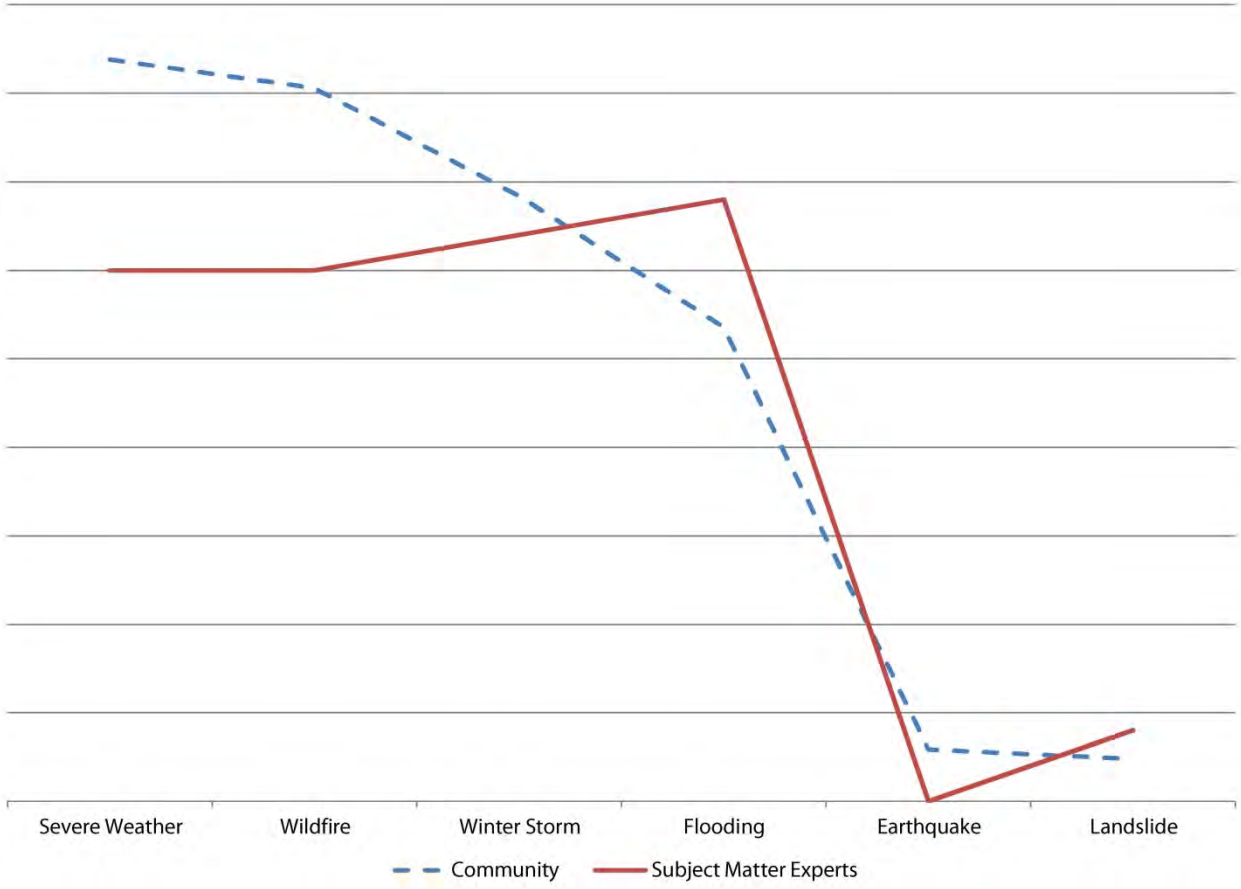
Public Notification of Planning Process and Public Input Survey: The City of Colorado Springs OEM conducted an online community survey to announce the update of the Plan and to obtain public input into the planning process. OEM posted information on the Plan update and survey on its website at the beginning of the planning process. Many of the LPC and stakeholders also helped publicize the Plan update process and the public input survey within their constituencies.

In addition to the public survey, 29 Subject Matter Experts (SMEs) were surveyed in May 2015 during the Kickoff Meeting. Figure 3-1, next page, summarizes the perceived threat for particular natural hazards in Colorado Springs according to both the community and the SMEs. This method of public interaction was selected rather than a meeting because better participation was anticipated. The public input survey was announced on July 16th on KRDO during a radio interview with Deputy Director Bart Howard. The survey was made available on July 27, 2015 and was open for three weeks. Another media story promoting the Plan update and survey ran during the week of August 3, 2015. There were 1,548 respondents to the public survey. Detailed results from the surveys are presented in Appendix B. The following general trends were noted:

- 56% of respondents are more than 50 years old (50-59 = 26%, over 60 = 30%)
- 50% of respondents have lived in the City more than 20 years
- 53% of responses from the downtown and western parts of the City (zip codes 80906, 80907, 80909, 80918, 80919, and 80920)
- 50% of respondents rate themselves as somewhat prepared, 15% as very prepared
- Television is the top choice for receiving information, edges out the Internet for second choice
- Top three natural hazards:
    - Severe Weather: 84%
    - Wildfire: 81%

  - Winter Storm: 68%
- Top three human-caused hazards:
  - Active shooter: 74%
  - Epidemic/Infectious Disease: 66%
  - Cyber Attack: 48%

Figure 3-1: Perceived Threat of Natural Hazards in Colorado Springs – Community vs. Subject Matter Experts



OEM and Colorado Springs officials are frequently working in the community to promote individual and organizational preparedness and hazard mitigation. Below are two examples of mitigation and preparedness meetings facilitated by City officials.

2014 Wildfire Preparedness Meeting: The Colorado Springs Fire Department (CSFD) hosted this meeting that in addition to discussing wildfire preparedness, emphasized hazard mitigation. In the meeting, it was discussed that residents should help report any signs of wildfire. A major theme was sharing the responsibility and the extensive efforts made to involve residents in the mitigation process. Colorado Springs maintains a Wildfire Mitigation (WM) webpage that has links to important wildfire mitigation information such as the Ignition Resistant Construction Design Manual, wildfire mitigation measure tax credit, Vegetation Management guidelines, and requirements for a safely zone as a result of Appendix K to the Hillside Overlay Zone.

March and April 2015 Flood Preparedness Meetings: OEM met with residents in the Mountain Shadows neighborhood to help them prepare for potential flooding that may occur downstream of the Waldo Canyon burn scar. The meeting included representatives from the National Weather Service and the National Flood Insurance Program. OEM stressed the need to have an emergency plan and keep enough supplies for 72 hours in case of potential flooding.

Public Review of Plan Draft: After comments by OEM were incorporated into a draft update of the hazard mitigation plan, it was made available for LPC, Stakeholder and general public review and comment. Members of the LPC worked together to make the plan available for public review in hard copy from January 21 through January 31, 2016, at the following locations:

Location 1: Penrose Library, 20 North Cascade Avenue
Location 2: East Library, 5550 North Union Boulevard
Location 3: Library 21c, 1175 Chapel Hills Drive

The plan was also available for electronic review on the City of Colorado Springs OEM site at: https://oem.coloradosprings.gov/.

The Colorado Springs OEM publicized the availability of the draft plan by issuing press releases to the *Colorado Springs Gazette* and the *Colorado Springs Independent*. Copies of the notifications and public comments received are included in Appendix B.

Step 3: Coordinate (with Other Departments and Agencies)

Colorado Springs OEM invited a range of local, state, and federal departments and agencies and other interested parties to be involved in the planning process. Table 3-2 lists many of the stakeholders who were intimately involved in the planning process. The LPC invited some additional interested parties to review and comment on the plan draft, including:

- City of Colorado Springs City Council
- Colorado Geological Survey
- Colorado Springs Regional Business Alliance
- Colorado State Forest Service
- Colorado State Patrol
- Colorado Water Conservation Board
- Council of Neighbors and Organizations
- Downtown Business Partnership
- El Paso/Teller County 911
- FEMA Region VIII
- Pikes Peak Rural Transportation Authority
- South Central Healthcare Coalition
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

Incorporation of Other Plans and Studies

As part of the coordination with other departments and agencies, AECOM and the LPC reviewed and incorporated existing plans, studies, reports, ordinances, and technical information. This information was used in the development of the hazard identification, vulnerability assessment, and capability assessment in Chapter 4 and in the formation of goals, objectives and mitigation actions in Chapter 6. These sources are documented throughout the plan and in Appendix F: References. The plans and studies specific to Colorado Springs included the following:

- Hazard Mitigation Plan for Colorado Springs, 2005 and 2010
- Colorado Springs HUD Consolidated Plan 2015-2019
- 2011 Colorado Springs Community Wildfire Protection Plan (CWPP) (which will be updated in 2016)

- 2008 Colorado Springs Forestry Management Plan
- Waldo Canyon Recovery plan (being revised in July 2015)
- Colorado Springs Open Space Plan
- 2012 Colorado Springs Emergency Preparedness and Safety Guide
- 2013 Colorado Drought Mitigation and Response Plan
- 2014 Emergency Operations Plan and OEM Annual Report
- Colorado Springs Capital Improvements Program
- Local by-laws, building codes, and zoning ordinances
- Flood Insurance Studies (amended 1997)
- 2015 and on-going Shook's Run Drainage Basin Planning Study
- 2013 Colorado State Natural Hazards Mitigation Plan
- 2015 Colorado Resiliency Framework
- City of Colorado Springs Water Shortage Ordinance, revised 2014
- City of Colorado Springs Comprehensive Plan
- City of Colorado Springs Stormwater Needs Assessment, Final Report, October 2013
- City of Colorado Springs Subdivision Code
- 2014 Ignition Resistant Construction Design Guideline
- City of Colorado Springs Zoning Code
- Colorado Springs Wildfire Mitigation Plan 2001
- City of Colorado Springs Hillside Manual and Appendix K (Wildland Urban Interface Mitigation Requirements for the Overlay Zone)
- Colorado Springs Infill and Redevelopment Analysis

Element B: Hazard Identification and Risk Assessment

Step 4: Identify the Hazards

At the Kickoff Meeting in May 2015 and the Risk Assessment Meeting in July 2015, AECOM presented information on the requirements for the risk assessment section of the Plan. Topics presented and discussed in this meeting are found in Table 3-4.

Step 5: Assess the Risks

A profile of each identified hazard was created using the best available Geographic Information Systems (GIS) data, online data sources, and existing plans and reports. The profiles included a hazard description, geographic location, past occurrences, probability of future occurrences, climate change impacts, magnitude/severity (extent), and a vulnerability assessment for each hazard. Members of the LPC provided information to AECOM about hazard data sources and past events in the city. The profiles also describe overall vulnerability to each hazard and identify structures and estimated potential losses to structures in identified areas for several hazards.

Members of the LPC also provided information to help update the mitigation capability assessment, which identifies the existing government programs, policies, regulations, ordinances, and plans that mitigate or could be used to mitigate risk to

disasters. This Plan includes information on the City of Colorado Springs' regulatory, personnel, fiscal, and technical capabilities, as well as ongoing initiatives related to interagency coordination and public outreach. This capability assessment is summarized in Chapter 5.

Element C: Mitigation Strategy

Step 6: Set Goals

At the Mitigation Strategy Meeting in September 2015, AECOM provided an overview of the mitigation strategy and the goals for the 2016 Plan. The LPC and stakeholders concurred with the goals to be included in this 2016 Plan.

Step 7: Review Possible Activities

The LPC identified and prioritized mitigation actions at the Mitigation Strategy Meeting. Details on this process are included in Chapter 6, Mitigation Strategy. The LPC identified the responsible agency and completed an implementation worksheet for each mitigation action. The purpose of these worksheets is to document background information, ideas for implementation, alternatives, responsible offices, partners, potential funding, cost estimates, benefits, and timelines for each identified action.

Step 8: Draft the Plan

AECOM developed a draft of the 2016 Plan document for review by the LPC, stakeholders, and the general public. The draft was made available online and in hard copy for review and comment by the public and other agencies and interested stakeholders. This review period was from January 21 through January 31, 2016. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3, and materials are provided in Appendix B. Comments were integrated into a final draft for submittal to the Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA Region VIII.

Elements D and E: Plan Review, Evaluation and Implementation, and Plan Adoption

Step 9: Adopt the Plan

The Colorado Springs City Council adopted the Plan with Resolution No. 41-16 on April 26, 2016. A copy of the resolution of adoption is included in the Adoption section of the Plan.

Step 10: Implement, Evaluate, and Revise the Plan

The LPC developed and agreed on a method and schedule for plan implementation and for monitoring, evaluating, and maintaining the plan over time. This information is described in Chapter 7, Plan Maintenance.

4. Risk Assessment

FEMA Requirements

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

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

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

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

Requirement §201.6(c)(2)(ii)(B): The plan *should* describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section.

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

EMAP Standards (2013)

Standard 4.3.1: The Emergency Management Program shall identify the natural and human-caused hazards that potentially impact the jurisdiction using a broad range of sources. The Emergency Management Program shall assess the risk and vulnerability of people, property, the environment, and its own operations from these hazards.

Standard 4.3.2: The Emergency Management Program shall conduct a consequence analysis for the hazards identified in standard 4.3.1 to consider the impact on the public; responders; continuity of operations including continued delivery of services; property, facilities, and, infrastructure; the environment; the economic condition of the jurisdiction and public confidence in the jurisdiction's governance.

This chapter profiles the natural hazards that affect the City of Colorado Springs and assesses vulnerability to those hazards. The risk assessment allows Colorado Springs to better understand its risks and provides a framework for developing and prioritizing mitigation actions to reduce risk from future natural hazard events.

This chapter is organized as follows:

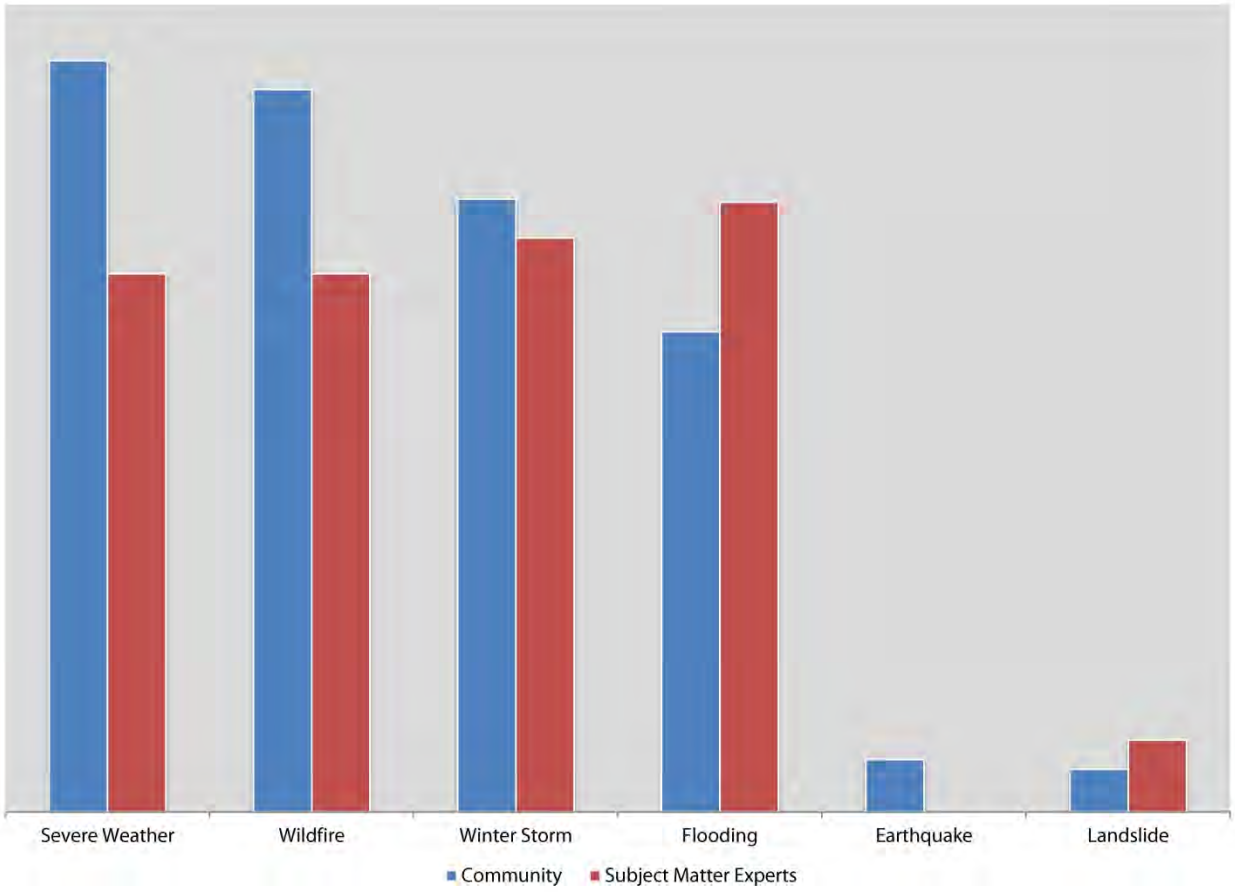
- **Section 4.1 Hazard Identification** identifies the hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.
- **Section 4.2 Hazard Profiles and Vulnerability** describes the different methods of analyzing the identified hazards including previous occurrences, potential magnitude, and expected future frequency.
- Hazard profiles in **Section 4.3** through **Section 4.7** describe the location of the hazard in the planning area, previous occurrences of hazard events, probability of future occurrence, and potential magnitude or severity for each identified hazard. These sections also describe overall vulnerability to each hazard and identify structures and estimate potential losses to structures in identified hazard areas.
- **Section 4.8 Hazard Profile Summary** assesses the city's total exposure to natural hazards and considers assets and populations at risk, including critical facilities and infrastructure; natural, historic, and cultural resources; economic assets; and socioeconomic variables.
- **Section 4.9 Community Asset Inventory** and **Section 4.10 Land Use and Development Trends** analyze trends in population growth, housing demand in hazard areas, and land use patterns.
- **Chapter 5 Capability Assessment**, formerly a part of the 2010 Plan Risk Assessment chapter, now stands on its own**.** This chapter outlines the existing programs, policies, and plans that mitigate or could be used to mitigate risk of natural hazards for each jurisdiction.

4.1 Hazard Identification

This section identifies the hazards that are likely to affect Colorado Springs. The LPC considered the hazards identified in the State of Colorado Natural Hazards Mitigation Plan (2013), the hazards recommended by FEMA (FEMA Publication 386-2, *Understanding Your Risks: Identifying Hazards and Estimating Losses,* 2002), the FEMA Local Mitigation Planning Handbook (2013) and the hazards identified in the previous Plan (2010). This section addresses EMAP Standard 4.3.1 by identifying the hazards using a broad range of sources.

Figure 4-1 illustrates the results of surveys conducted in May and August 2015. It compares the perceived threat of natural hazards from two perspectives: 1) local emergency management professionals and other stakeholder SMEs, and 2) a random sample of City residents, known as the Community.

Figure 4-1: Perceived Threat of Natural Hazards, Colorado Springs 2015



Source: AECOM, Created from survey results gathered during the planning process in May and August, 2015.

Detailed results of the surveys are presented in Appendix B. The survey results indicate that both the SMEs and the community perceive wildfire, severe weather, and winter storms as top natural hazard threats to Colorado Springs, but the community is generally more concerned about those hazards, while the SMEs are more concerned about flooding. The figure also shows that both groups are only slightly concerned about landslide, and while the community is slightly concerned with earthquakes, none of the SMEs are concerned with earthquakes in comparison to other identified hazards.

Events that triggered federal and/or state disaster declarations were also reviewed. Disaster declarations are typically made at the county level and may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration. FEMA also issues emergency declarations, which are more limited in scope and do not warrant the long-term federal recovery programs of major disaster declarations.

Table 4-1 lists state, federal, and local disaster declarations in which El Paso County was a designated county. Many of these declarations were for flooding, wildfire and severe storms.

Table 4-1: Disaster Declaration History in El Paso County, 1965 – August 2015

Year	Event Type	Type of Declaration
1965	Tornadoes, Severe Storms, & Flooding	Presidential Disaster
1969	Severe Storms & Flooding	Presidential Disaster
1973	Heavy Rains, Snowmelt, & Flooding	Presidential Disaster
1976	Severe Storms & Flash Flooding	Presidential Disaster
1989	Wildfires	Local
1990	Tornado	State
1993	Flooding	Local
1995	Wildfire	Local
1995	Flooding/Landslides	State
1997	Snow Emergency	State
1999	Colorado Severe Storms, Flooding, Mudslides, and Landslides	Presidential Disaster
2001	Severe Weather	Presidential Disaster
2006	Severe Winter Storm	State
2007	Snow	Presidential Emergency
2009	Severe Spring Snowstorm	State
2009	Severe Blizzard	State
2012	Flooding	State
2012	Wildfire	State
2012	Wildfire	State
2012	Colorado High Park And Waldo Canyon Wildfires	Presidential Disaster
2013	Wildfire	State
2013	Colorado Black Forest Wildfire	Presidential Disaster
2013	Colorado Severe Storms, Flooding, Landslides, and Mudslides	Presidential Disaster
2013	Flooding	State
2013	Flooding	State
2015	Flooding	Presidential Disaster

Source: State of Colorado Natural Hazards Mitigation Plan, 2013; Public Entity Risk Institute Presidential Disaster Declaration Site, www.peripresdecusa.org/mainframe.htm (no longer available), November 12, 2009.and FEMA website (https://www.fema.gov/disasters) August, 2015.

United States Department of Agriculture Disaster

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

As shown in Table 4-2, from 2005 to 2007 (only years available), the Farm Service Agency (FSA) of the USDA issued eight disaster declarations affecting El Paso County, Colorado. Most of these declarations resulted from either periods of drought or severe winter storms.

Table 4-2: Farm Service Agency Disaster Designations, El Paso County 2005-2007

Year	Hail	Drought	Insects	Wildfires	High Winds	Excessive Heat	Below Normal Temp.	Winter Storms	Excessive Moisture
2005		✓							
2005	✓				✓				✓
2006							✓	✓	
2006		✓		✓	✓	✓			
2006		✓	✓		✓	✓		✓	
2006									✓
2006		✓							
2007							✓	✓	

Source: USDA Farm Service Agency, www.fsa.usda.gov/Internet/FSA_File/2005_2007eligible_county.xls, accessed January 2010. 2016 Update: Updated information was not available from FSA during the plan update.

The 2005 Plan identified flooding, wildfire, landslides, and severe weather as posing the most risk to Colorado Springs. The 2010 Plan profiled the same hazards identified in the 2005 Plan, with the addition of windstorms and dam and levee failure. The 2016 Plan re-defines the hazards as five distinct hazards with various impacts (e.g., hail and lightning in severe weather), as listed in Table 4-3. The hazard impacts profiled in the 2010 update are included as well as adding a more robust description of human-caused hazards. Other hazards included in the 2013 State Mitigation Plan were also considered. Climate change is addressed as it impacts other hazards.

In 2013, hazardous weather in Colorado resulted in:

- 19 deaths
- 41 injuries
- $1,011,120,000 in damage

Source: 2013 Summary of Hazardous Weather Fatalities, Injuries, and Damage Costs by State, National Weather Service, http://www.nws.noaa.gov/os/hazstats/state13.pdf, accessed June 2015.

Table 4-3: Hazards Identified in the 2016 Plan

Hazard	Hazard Impacts or Variations
Flood	Flood (including Flood Risk after Fire), Dam and Levee Failure
Wildfire	Wildfire
Geologic Hazards	Earthquakes, Landslides, Subsidence, and Rockfall
Severe Weather	Hail, Lightning, Tornadoes, Windstorms, Severe Winter Storms, and Drought
Human-Caused Hazards	Hazardous Materials Incidents, Terrorism, and Infectious Disease

These hazards were presented to the LPC and Stakeholders in both the Kickoff and Risk Assessment Meetings. Other hazards not profiled in the plan, due to the low likelihood of occurrence (e.g., no incidents reported on the National Climatic Data Center [NCDC] Storm Events Database, now known as the National Centers for Environmental Information [NCEI] Storm Events Database) or low probability that property or populations would be significantly affected, are listed in Table 4-4 along with an explanation.

In the 2005 and 2010 Plans, extensive reference is made to data gathered from the National Climatic Data Center. At the end of 2014, the 113th Congress passed House Resolution 83, making the Consolidated and Further Continuing Appropriations Act of 2015 law. This resolution authorized consolidation of the National Oceanographic and Atmospheric Administration's three existing National Data Centers, the National Climatic Data Center, the National Geophysical Data Center, and the National Oceanographic Data Center into the National Centers for Environmental Information (NCEI).

Throughout this 2016 Plan, where there might previously have been a reference to the NCDC, there is now a reference to the NCEI.

Source: About the National Centers for Environmental Information, https://www.ncei.noaa.gov/about, accessed February 2016.

Table 4-4: Hazards Not Profiled in Plan

Hazard	Explanation for Omission
Avalanche	An avalanche forecasting area is defined surrounding Pikes Peak; however no previous occurrences in Colorado Springs were discovered through research of this hazard, nor are expected to occur within the city limits. No avalanche incidents were found in NCEI events database.
Erosion and Deposition	For this plan, it is considered part of flood hazard found in Section 4.3
Expansive and Collapsible Soils	Although underlying swelling clays exist in Colorado Springs, they are fairly common across the entire Front Range. While these types of soils can affect individual structures, the overall impacts are negligible and are mitigated through existing development policies and practices. No expansive soil incidents were found in NCEI events database.
Extreme Heat	This hazard has not created problems in the past that are unrelated to drought. It is primarily an issue of human and livestock health. Since 1995, there were no recorded deaths in Colorado caused by extreme heat (per the National Weather Service). No extreme heat incidents were found in NCEI events database.
Pest Infestation	There are a variety of insect infestations that could and do impact the forest to include the Tussock Moth, Spruce Bugworm, Ash Borer, and Bark Beetle. Each of these is a contributing factor to the wildfire risk described in Section 4.6, Wildfire.

4.2 Hazard Profiles and Vulnerability

Each of the hazards identified as posing a threat in Colorado are profiled in subsequent sections. Each profile includes a summary of the overall risk and vulnerability for each identified hazard. This section describes the research methodology and defines the elements of the hazard profiles.

The sources used to collect information for the hazard profiles include, but are not limited to the following:

- Colorado Springs OEM
- State of Colorado Natural Hazards Mitigation Plan (2013)
- Colorado Springs Hazard Mitigation Plan for Colorado Springs (2010)
- Colorado Resiliency Framework (2015)
- Colorado Springs Forestry Management Plan (2008)
- Waldo Canyon Watershed Assessment of River Stability and Sediment Supply (WARSSS): The *WARSSS* Results (2013)
- Colorado Springs Water Conservation Plan (2012)

- Colorado Springs Drought Mitigation and Response Plan (2013)
- Colorado Springs Community Wildfire Protection Plan (CWPP) (2011)
- Information gathered from the City of Colorado Springs website
- Local news information
- Information on past extreme weather and climate events from the NCEI
- Disaster declaration history from FEMA, the Public Entity Risk Institute (PERI), and USDA-FSA
- Information on natural hazards gathered from the U.S. Geological Survey (USGS)
- Information on natural hazards gathered from the Colorado Geological Survey (CGS)
- Information on mitigation and previous events from the Colorado Water Conservation Board (CWCB)
- Information on drought occurrences from the National Drought Mitigation Center (NDMC)
- Geographic information systems (GIS) data from the City of Colorado Springs
- Existing plans and reports
- Meetings and data collected from the LPC

Detailed profiles and vulnerability assessments include the following characteristics of each identified hazard:

Hazard Description provides a general description of the hazard and considers the relationship between hazards.

Geographic Location describes the geographic extent or location of the hazard in the planning area and determines which participating jurisdictions are affected by each hazard.

Previous Occurrences includes information on the known hazard incidents and information related to the impact of those events, if known. Information from the 2010 Plan was used in addition to numerous other resources to build upon the event history for the 2016 Plan.

Probability of Future Occurrence uses the frequency of past events to estimate the likelihood of future occurrence. The probability, or chance of occurrence, was calculated based on existing data. The probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This provides the percent chance of the event happening in any given year. For example, three droughts occurring over a 30-year period suggests a 10% chance of a drought occurring in any given year.

Based on historical data, the probability of future occurrences is categorized as follows:

- *Highly Likely:* Near 100% chance of occurrence next year or it happens every year
- *Likely:* 10-100% chance of occurrence next year or a recurrence interval of 10 years or less
- *Occasional:* 1-10% chance of occurrence in the next year or a recurrence interval of 11 to 100 years
- *Unlikely:* Less than 1% chance of occurrence in the next 100 years or a recurrence interval of greater than every 100 years

Climate Change Impacts summarizes the extent or potential extent of the level of climate change on hazards.

Magnitude/Severity summarizes the extent or potential extent of a hazard event in terms of deaths, injuries, property damage, and interruption of essential facilities and services.

Magnitude and severity is categorized as follows:

- *Catastrophic:* Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and service for more than 72 hours
- *Critical:* Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours
- *Limited:* Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours
- *Negligible:* No or few injuries or illnesses; minor quality of life loss; little or no property damage; and/or brief interruption of essential facilities and services

The LPC used discretion to modify some of the probabilities and magnitudes when necessary.

Vulnerability Assessment describes the county's overall vulnerability to each hazard; identifies existing and future structures, critical facilities, and infrastructure in identified hazard areas; and estimates potential losses to vulnerable structures, where data is available. This Plan used FEMA's most recent Hazus software (version 2.2) for estimating losses attributed to flooding and earthquakes. This Hazus update has more recent population data (2010 U.S. Census) and updated values for the building stock (2014 RS Means). The 2016 Plan used the available data at the time to estimate losses, identify assets, and analyze development trends. This section meets the intent of EMAP Standards 4.3.1 and 4.3.2 by assessing the vulnerability of people, property, and the environment from these hazards.

Data Limitations indicates where the Planning Team encountered data limitations when completing the hazard profile.

4.3 Flood, Dam and Levee Failure

Flood, Dam and Levee Failure are events where rising water damages property and poses risk to life safety. While generally different in origin, flood, dam failure and levee failure cause damage from inundation and velocity. For Colorado Springs, these include the following:

- Flood
- Dam and Levee Failure

4.3.1 Flood

Hazard Description

Colorado Springs is at risk to riverine and stormwater flooding. Riverine flooding is defined as when a watercourse exceeds its "bank-full" capacity and generally occurs as a result of prolonged rainfall, or rainfall that is combined with soils already saturated from previous rain events. The area adjacent to a river channel is

its floodplain. In its common usage, "floodplain" most often refers to that area that is inundated by the 100-year flood, the flood that has a 1% chance in any given year of being equaled or exceeded. The 1% annual chance flood (or base flood) is the national standard to which communities regulate their floodplains through the NFIP.

Stormwater refers to water that collects on the ground surface or is carried in the stormwater system when it rains. In runoff events where the amount of stormwater is too great for the system, or if the channel system is disrupted by vegetation or other debris that blocks inlets or pipes, excess water remains on the surface. This water may pond in low-lying areas, often in street intersections. Stormwater ponding, also known as localized flooding, may result in deep water and pollution. Stormwater can pick up debris, chemicals, dirt, and other pollutants from impervious surfaces.

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 development and can also be created by other events such as wildfires. Wildfires create hydrophobic soils, a hardening of the earth's surface that prevents rainfall from being absorbed into the ground, which can increase runoff, erosion, and downstream sedimentation of channels.

Due to the Waldo Canyon and Black Forest Wildfires of 2012 and 2013, respectively, there is an emphasis on estimating the changed hydrology in post-wildfire downstream areas. This is discussed in detail in the Flood after Fire part of this section.

Geographic Location

Flooding in Colorado Springs has been historically widespread geographically. Many of the rivers within the City overflow their banks during large events, which leaves several areas within the city vulnerable to flood damage. Figure 4-2 shows the geographic extent of the stream network in the City.

Picture on left: Cheyenne Creek Flooding, May 2015. Picture on right: Sandbagging to help protect Colorado Springs, April 2013. Source: City of Colorado Springs

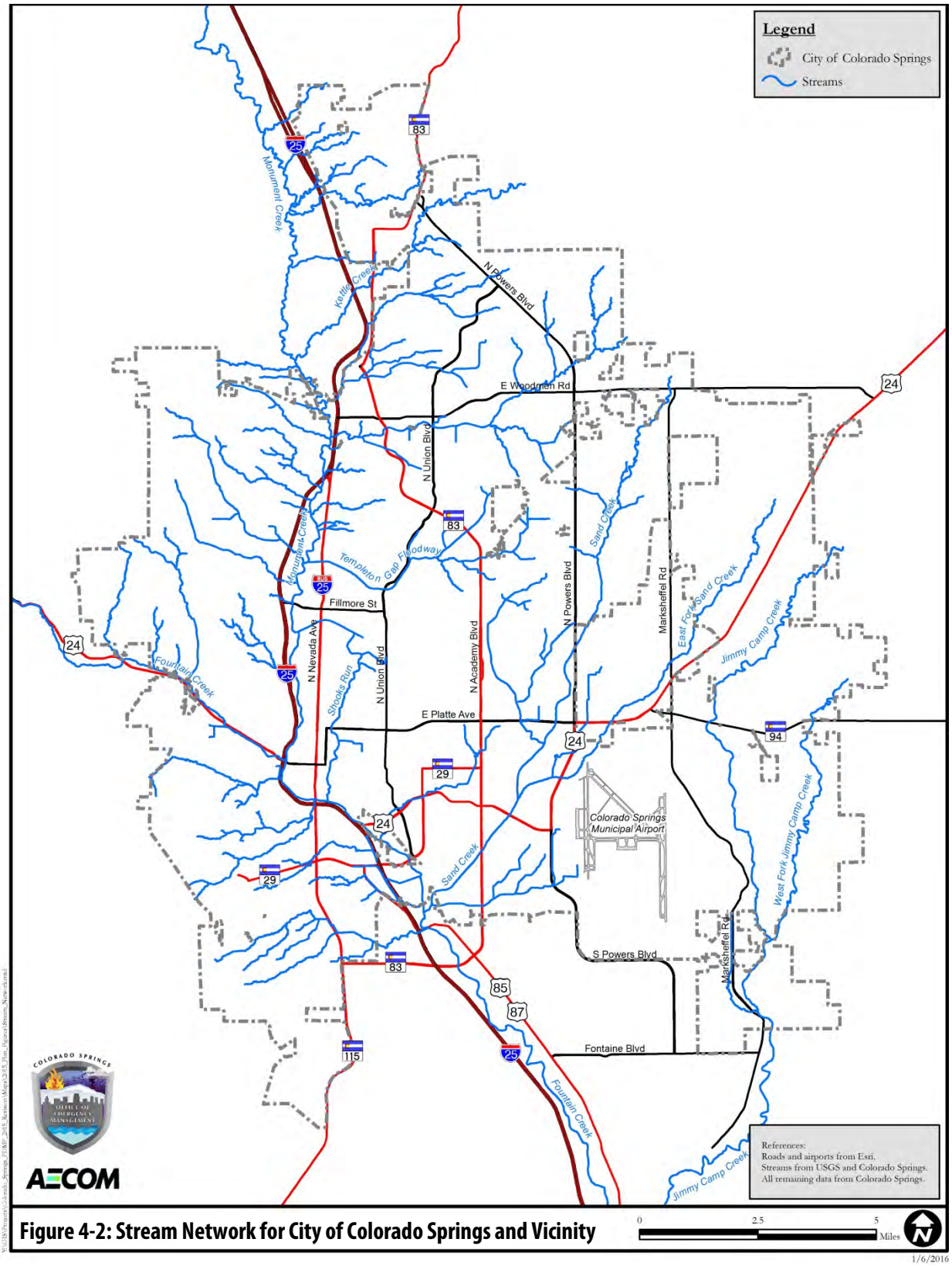


Figure 4-2: Stream Network for City of Colorado Springs and Vicinity

The following is an excerpt from the 2005 PDM Plan:

> *The two largest creeks in Colorado Springs are Fountain Creek and Monument Creek. Monument Creek flows south and enters the City near the Air Force Academy. Fountain Creek flows east and enters the City just east of Manitou Springs. Monument Creek empties into Fountain Creek near the intersection of I-25 and Highway 24 or just west of the downtown area. Once Monument Creek reaches this confluence it empties into Fountain Creek and the combined creek is known as Fountain Creek. The Fountain Creek then flows south to Pueblo. There are other, smaller drainages within Colorado Springs.*

Previous Occurrences

Colorado Springs has a long documented history of flooding events dating as far back as 1864 and as recent as August 2015.

Figure 4-3: Monument Creek Flood 1965, View at Uintah Street Bridge

Source: Pikes Peak Library District Special Collections Photo Archives, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=002-3253-di-72.jpg;&view=1, accessed on November 30, 2009.

Picture on left: Flooding at intersection of 31st Street/Fontanero, September 13, 2013. Picture on right: Stormwater channel damage from May and June 2015 flooding. Source: City of Colorado Springs

Table 4-5: Major Floods in Colorado Springs

Year	Description of Event	Data Source
1864	Flooding below Cheyenne Mountain, ravines in torrents 20-30 feet deep.	FIS 1997
1878	Heavy rains from Palmer Lake cloudburst caused flooding that swept out bridges along Monument and Fountain Creeks.	FIS 1997
1882	Flood down Ute Pass in Manitou, bridges and railroad tracks destroyed, 1 victim.	2005 PDM Plan
1885	Rainfall of about 16 inches within a short time frame, 5 miles northeast of Templeton Gap.	FIS 1997
1886	Major flood similar to that of 1885.	2005 PDM Plan
1894	Flooding of the South Platte and Arkansas River basins. High water on Fountain Creek washed away bridges, and a home at the south end of the West First Street bridge.	FIS 1997
1915	"Great Sand Creek Flood" – east Colorado Springs, 3 victims.	2005 PDM Plan
1921	Shooks Run became a river. Sand Creek and Fountain Creek were flooding farms, ranches, and houses.	FIS 1997
1922	Intense downpour over the Templeton Gap drainage area produced 6 inches of rain. A residential district in the eastern portion of the City was inundated, causing $59,700 in damage.	FIS 1997
1929	College Gulch flooded by a 15 foot wall of water caused by the breaking of dams on Ute Pass Fish Club – wiped out Crystola, Midland tracks, 1 victim.	2005 PDM Plan
1932	Maximum known flood in the Templeton Gap area. Caused over $144,000 in damage. This storm flooded most of northern Colorado Springs.	FIS 1997
1935	Memorial Day Flood, largest recorded flood: 55,000 cfs on Fountain Creek above the confluence with Jimmy Camp Creek. This storm also caused the largest flood known on Monument Creek at 50,000 cfs. In Colorado Springs, Monument Creek attained its peak flow within 2.5 hours. The flow rate of this flood exceeded the estimated 500-year peak flow rate. At least 4 lives were lost to this flood.	1997 El Paso County Flood Insurance Study (FIS) /2005 PDM Plan

Year	Description of Event	Data Source
1935	Monument Creek flood from half a dozen cloudbursts. Four lives lost in Colorado Springs, and property damage was estimated at $1,215,000 by the City Engineer.	FIS 1997
1965	Jimmy Camp Creek flood, with estimated peak discharge of 124,000 cfs 4.5 miles above the confluence with Fountain Creek. This recurrence interval was far exceeding 500 years.	FIS 1997
1965	Flash floods cause major landslide at Cheyenne Mountain Zoo. Flood resulted in four fatalities and caused major destruction in currently developed areas.	2005 PDM Plan
1970	Flash floods cover Constitution Ave. to Fountain Blvd., 1 victim.	2005 PDM Plan
1970	9-11 inches of rain caused flooding and rock slides in Rock Creek Canyon.	2005 PDM Plan
1972	Jimmy Camp Creek washout, $50,000 in damage to roads and bridges.	2005 PDM Plan
1979	Major flooding causing $793 in damage.	SHELDUS*
1980	Major flooding causing $250,000 in damage.	SHELDUS*
1981	Major flooding causing $50,000 in damage.	SHELDUS*
1985	I-25 closed down, nearly 2-5 inches of rain, Gold Camp and Old Stage Roads closed.	2005 PDM Plan
1994	Flash flooding in Colorado Springs. Many roads were closed due to the high water. Two people slightly injured when they tried to drive their vehicles across rushing water over a dip in a road and were washed away. Damage to a local golf course on June 2.	NCEI
1994	Flooding of streets in Colorado Springs June 20.	NCEI
1994	Flash flooding causing overflow at west entrance to Peterson Air Force Base.	NCEI
1994	Water washed rocks from a hillside onto a highway. Road was closed, and several cars were washed into the ditch. September 3.	NCEI
1995	Northern and eastern Colorado Springs had at least six inches of water covering many streets. Many locations received over 2 inches of rain in 3 hours. $1 million in damage.	NCEI/ SHELDUS*
1996	Moist upslope flow aided in the development of strong thunderstorms along the Front Range on May 24. Some areas near the airport received 2 ½ inches of rain in as many hours.	NCEI
1996	July 26, very heavy rain of 1 to 3 inches caused flooding of roads and underpasses. Vehicles were partially submerged at the intersection of Walnut Street and Colorado Avenue.	NCEI
1997	Heavy thunderstorms dumped rain on Fountain and Cheyenne Creek Basins, causing flash floods and a prolonged period of high water.	NCEI
1997	Flooding of Interstate 25 and Highway 85/87 on June 13. Flooding of Fountain Creek just south of Downtown Colorado Springs.	NCEI
1997	Heavy thunderstorms across Colorado Springs on August 4 produced urban and small stream flooding causing drainage ditches to run rapidly and swell to levels of 6 to 8 feet. Two boys were swept away by the fast flowing water, of which one of them, 6-year old Steven Powell, drowned and was found the next morning.	NCEI/ SHELDUS*
1998	Vehicles stalled and businesses flooded. Flood waters left up to a foot of mud in low lying areas, swept away fencing and washed away landscaping. July 30, a rock and mud slide blocked Highway 24 one mile north of Manitou Springs.	NCEI
1998	Slow moving thunderstorms produced heavy rainfall across parts of the City resulting in numerous reports of street flooding. Some intersections were under 12 to 18 inches of water.	NCEI

Year	Description of Event	Data Source
1999	Flash Flooding caused street flooding, basement flooding, and evacuated some residents due to potential electrical problems.	NCEI
1999	Major flooding causing $32,565,151 in damage from April 29 to May 1. Over $327,000 in damage to crops. U.S. Army Corps of Engineers (USACE) considered this a 10-year event. The bridge at 21st Street over Fountain Creek was closed for 3 weeks for repairs.	2005 PDM Plan/NCEI /SHELDUS*
2000	Heavy rains flooded streets.	NCEI
2001	Intense rainfall at times exceeding 2 inches per hour caused serious flooding concentrated near downtown Colorado Springs. Interstate 25 at the Bijou Street bridge flooded when the water pump failed due to a lightning strike. The Highway was closed for about 10 hours and traffic was rerouted through downtown Colorado Springs.	NCEI
2002	Slow moving thunderstorms dropped 1 to 3 inches over much of Colorado Springs causing flooding of Fountain Creek.	NCEI
2004	Flash flooding caused streets to become flooded along with water coming out of manhole covers and stalled vehicles.	NCEI
2004	Flooding of streets, intersections. Vehicles floating and/or abandoned. Many streets were closed, including the underpass at mile-marker 123 on I-25. $200,000 in damage.	NCEI/ SHELDUS*
2005	A severe thunderstorm moved across the eastern side of the City, causing copious amounts of hail and rain. Two teenage boys drowned when they were taken by a wave of water in a drainage culvert on Cottonwood Creek near Woodmen Road. Near the Citadel Mall, a 3 to 4 foot deep lake developed with massive amounts of hail pouring into the deep water. Some motorists and passengers suffered minor hypothermia in the icy cold water. $100,000 in damage.	NCEI/ SHELDUS*
2005	Heavy rains caused two to two and a half feet of water to run over roadways, stranding several vehicles.	NCEI
2007	1 to 3 inches of rain in less than 2 hours caused flooding of roads. Water depths around one foot were reported around Powers Blvd. and in the Stetson Hills subdivision.	NCEI
2008	Roads closed due to high water, when 4 inches of rain pounded the east side of the City. Fountain Creek reached flood stage. $20,000 in damage.	NCEI/ SHELDUS*
2009	May 22, heavy rains brought flash flooding to South Cheyenne Canyon causing mud and rock slides and flooding of a road.	NCEI
2009	May 24, heavy rains flooded streets. There was water up to car windows at the intersection of South Walnut and West Cucharras.	NCEI
2009	July 7, a nearly stationary thunderstorm produced heavy rain and flooding on the west side of Colorado Springs.	NCEI
2009	July 26, heavy rains flooded streets. Water up to 10 inches deep was noted at the intersection of Tutt and Constitution.	NCEI
2011	August 2, slow moving thunderstorms produced flash flooding in the Colorado Springs metro area.	NCEI
2011	September 14, heavy rain in the Colorado Springs metro area caused Fountain Creek to flood from Colorado Springs to Pueblo. Moderate flooding occurred at Pinon (Pueblo County). The flood waters entered the Arkansas River and caused moderate flooding of agricultural land near Avondale.	NCEI
2012	June 6, significant flooding occurred in low lying areas on the east side of Colorado Springs. Near the Citadel Mall, a flood prone intersection saw hail collecting to a depth of around four feet in the intersection. Numerous vehicles were stalled and abandoned and water rescues were necessary. Other intersections with poor drainage flooded on the east side of the city. Some basement flooding occurred.	NCEI

Year	Description of Event	Data Source
2012	July 30, heavy rain occurred over a large portion of the Waldo Canyon burn scar from late afternoon through early morning. A flow of ash and gravel covered U.S. Highway 24 to a depth of five feet, stranding a truck and trailer. Debris flowed down Sand Gulch into the playground of the Ute Pass Elementary School and into two houses on the other side of Chipita Park Road. Debris in Wellington Gulch roared through a campground, which sustained damage to buildings and the property. Heavy damage was done to CSU roadways and a backup water pipeline around Nichols and Northfield Reservoirs.	NCEI
2013	September 12, storms produced heavy rain across western Pueblo County and western El Paso County and the Waldo Canyon burn scar. Rural roads were flooded east of Beulah. There was also flooding on U.S. Highway 24 and numerous streets on the west side of Colorado Springs. A man drowned in Fountain Creek near Nevada Avenue.	NCEI
2013	September 14, flooding occurred on Cheyenne Creek, causing flooding of houses and roads.	NCEI
2014	July 16, severe thunderstorms produced hail up to two inches in diameter and thunderstorm wind gusts in excess of 65 mph. Heavy rain produced flash flooding across El Paso County, including the areas in and near the Waldo Canyon burn scar.	NCEI
2014	October 9, the remnants of a tropical system brought heavy rain to portions of the Pikes Peaks Region, including Colorado Springs, where numerous streets were flooded.	NCEI
2015	In May and early June 2015, Colorado Springs received very high rainfall that caused approximately $13 million in damage to public infrastructure and approximately $8 million of damage to CSU. During this 40-day period, the City experienced erosion in public parks, blown out culverts, and utility damage. An approximate 500 to 600 homes reported basement flooding. The City submitted a request through the state for a presidential disaster declaration. May 2015 was greatest amount of rainfall in a single month for any Colorado county in recorded weather history. From May 1 to May 25, 13.27 inches of total precipitation were reported from one station[10]. This event received a Presidential Disaster Declaration, FEMA DR-4229-CO, on July 17, 2015 for Public Assistance in El Paso County including Colorado Springs.	Colorado Springs OEM, FEMA website
2015	On August 10, heavy precipitation over the Waldo Canyon burn scar area caused a flash flood event that affected many roadways and especially the Alpine Autism Center at the base of Queen's Canyon. The center was partially protected by sand cribbing and a detention basin but the structure was still flooded. It was estimated that the floods occurred less than 30 minutes after the precipitation event started.	OEM

*Data from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. Damage estimates provided by SHELDUS are divided amongst the affected county for disasters that affected multiple counties.

[10] From National Weather Service at http://www.weather.gov/bou/MayPrecip2015

Post-event pictures at the Alpine Autism Center after the August 10, 2015 flash floods. Floodwaters penetrated the protective sand cribbing. Source: City of Colorado Springs

Flood After Fire

Wildfires in the upstream and high elevation parts of Waldo Canyon have significantly impacted the hydrology of the watershed. The burning of the forest causes a virtually impervious surface due to the destruction of forest floor vegetation, burned tree material like sap, and the ash itself. Rainfall simply runs off this hardened surface, known as 'hydrophobic' soils, and there is very little ground absorption of the water. In addition, plant materials and leaf litter provide a buffer to the soil and give time for runoff to be absorbed. Once these materials and litter are removed after a fire, severe erosion can also occur. As water runs downhill through burned areas it can create major erosion and pick up large amounts of ash, sand, silt, rocks and burned vegetation, especially damaged trees. The force of the rushing water and debris can damage or destroy culverts, bridges, roadways, and buildings even miles away from the burned area.

The resulting diminished water storage and the steep slopes of the upper watershed create high quantity and velocity flows as well as erosion, sedimentation, and deposition. The Waldo Canyon Fire, which is described in greater detail in Section 4.11, had a burn area that covered 18,247 acres and generally extends north from U.S. Highway 24 to West Monument Creek, and northwest from the Colorado Springs city limits to Rampart Reservoir. The fire started Saturday, June 23rd, 2012, and was fully contained Tuesday, July 10th, 2012, destroying 346 homes.[11] The burn area was studied by the U.S. Forest Service (USFS) Burn Area Emergency Response (BAER) team with support from the USGS in July and August of 2012. The BAER team produced a field based soil burn severity map dated July 14, 2012 and a post-fire hydrology report dated July 16, 2012[12].

Locations downhill and downstream from the burn scar are now susceptible to flash flooding and debris flows, especially near steep terrain. The hydrology in the area has increased as rainfall that would normally be absorbed is running off more quickly.

[11] Waldo Canyon Fire Watershed Assessment: The *WARSSS* Results, 2013, http://adm.elpasoco.com/emprep/Documents/1.%20Waldo%20Canyon%20Fire%20Assessment%20Report[1].pdf, accessed June 14, 2015

[12] The BAER Team Report can be found at the Pikes Peak Library Special Collections Department online at: http://cdm15981.contentdm.oclc.org/cdm/singleitem/collection/p15981coll3/id/436

The susceptibility to flash flood and erosion within the burned area is expected to increase significantly the first three to seven years following the fire. Rain storms that develop over burn areas can produce flash flooding and debris flows nearly as fast as National Weather Service radar can detect the rainfall. If heavy rainfall is observed even for a very short time there is the potential for flash flooding and/or debris flows.[13]

A post-fire flood study, the Watershed Assessment of River Stability and Sediment Supply (WARSSS) study, prepared in 2013 for El Paso County and funded by several local partners and the CWCB describes and substantiates the risks of increased flooding from the burn scar. The study revealed that post-fire peak flows were generally two to four times greater than pre-fire peak flows in the following stream reaches:

- Upper Fountain Creek from Sand Gulch to the confluence with Monument Creek (13 miles)
- Camp Creek from the USFS boundary to its confluence with Upper Fountain Creek (1.2 miles)
- North and South Douglas Creeks

The Hazus results provide more detail on what this means for loss estimation for three of the watersheds where sufficient post-fire hydrology is available. The 2013 State Mitigation Plan describes the erosion issues in Colorado Springs after the Waldo Canyon Fire:

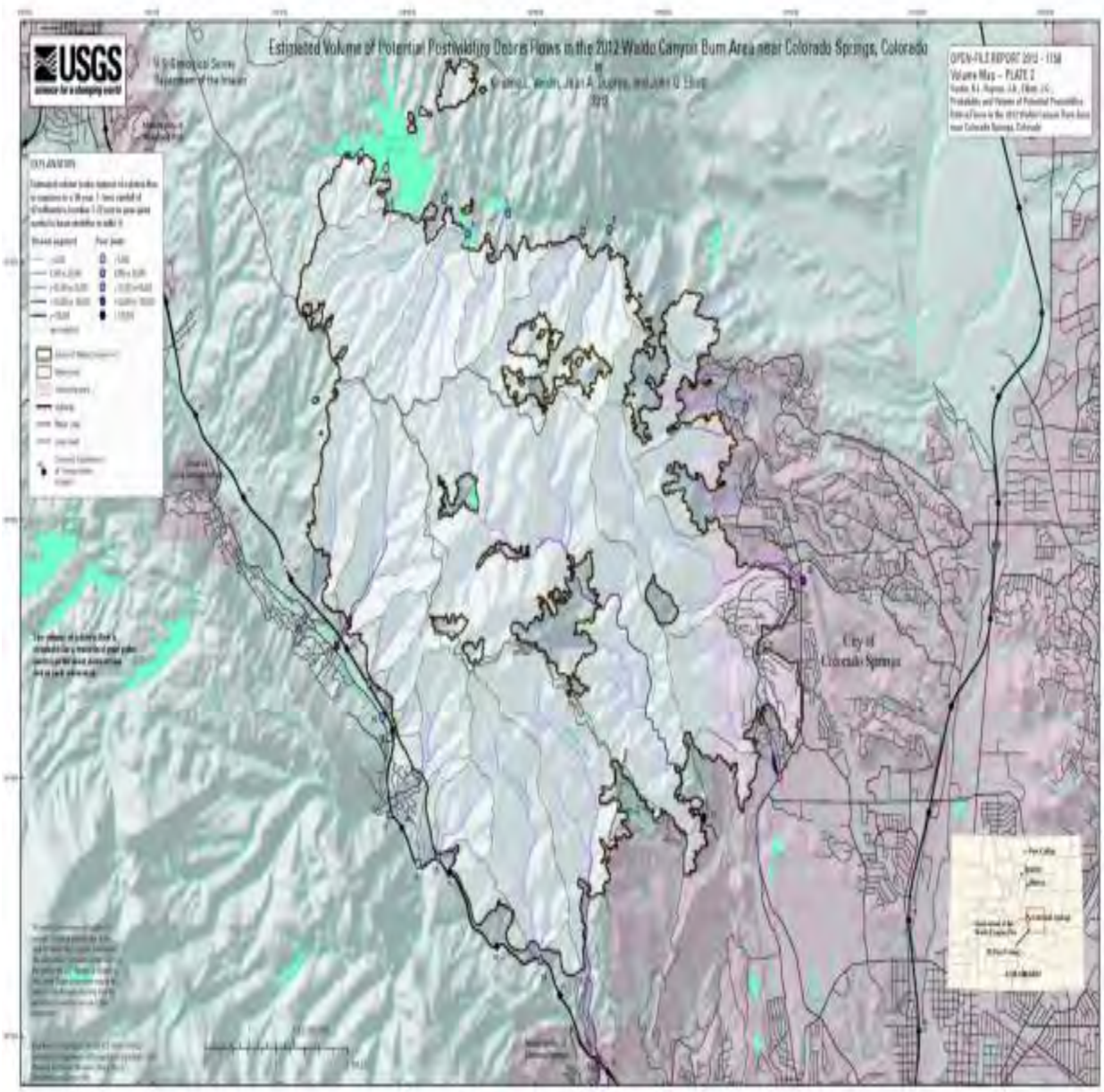
> *The Fountain Creek watershed presents erosion and deposition problems downstream to as far as La Junta. There were historic erosion problems through Woodland Park with associated sedimentation problems. Erosion problems are also evident in the stream banks upstream of the Old Crystola Road. Sedimentation and flooding occur downstream in many reaches causing issue during periods of high streamflow. Flooding and erosion in this watershed have accelerated the loss of aquatic and wetland habitats, contributed to the loss of hundreds of acres of productive farmland, and caused the foundations of roads and homes to crumble.*

Post-fire hazard mitigation at the Flying W Ranch after the Waldo Canyon fire to help reduce the impact of flooding after fire, August 2013. The re-establishment of vegetation in the burn scar can help reduce runoff volume and erosion but generally takes 5 to 7 years to take hold after planting. See Section 6.4 for post-wildfire actions to re-vegetate and install sediment catchment basins.

[13] NOAA National Weather Service, http://www.weather.gov/riw/burn_scar_flooding, assessed May 12, 2015

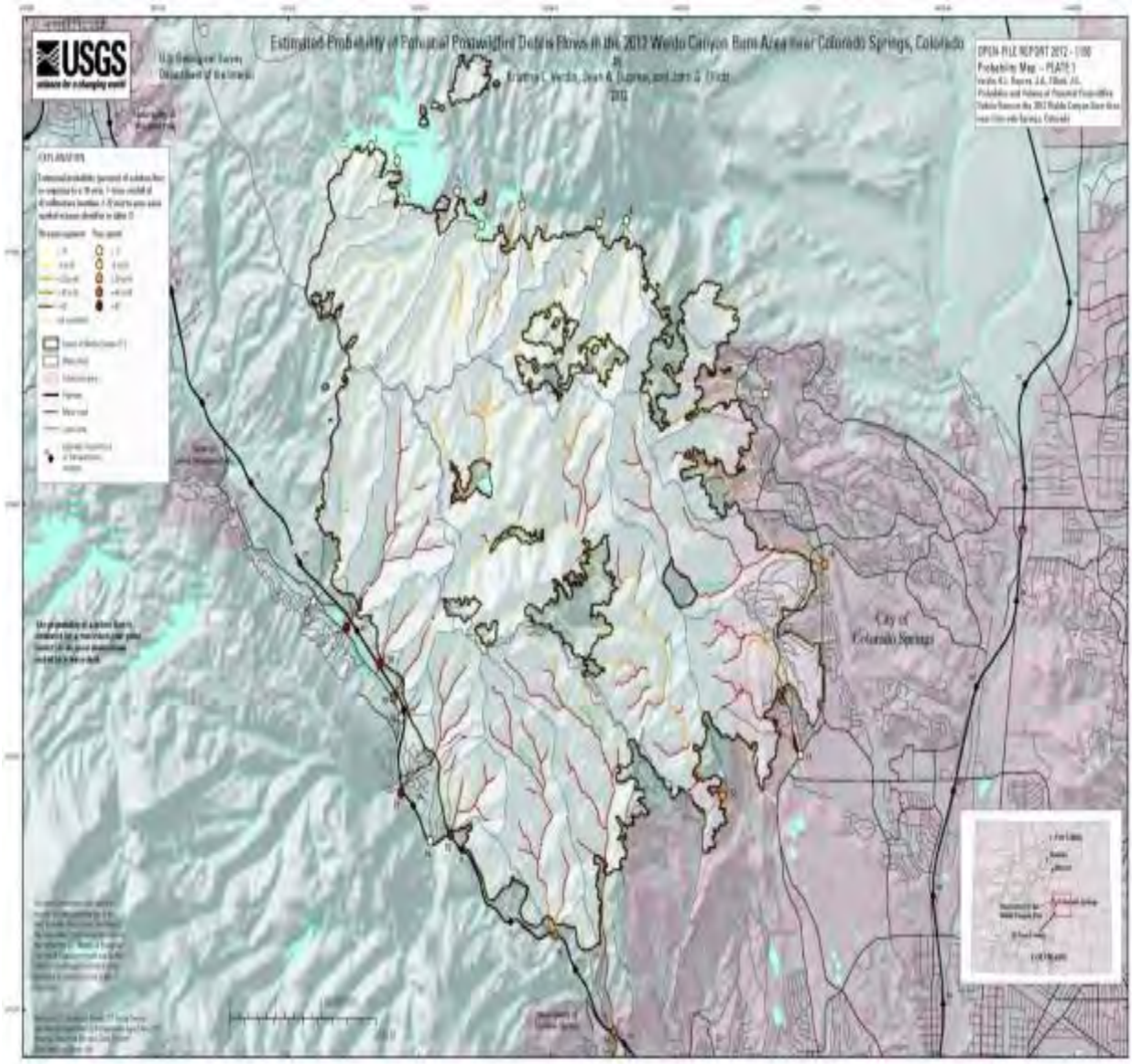
Figure 4-4 and Figure 4-5 show the potential volume and probability of debris flows after the Waldo Canyon Fire.

Figure 4-4: USFS Waldo Canyon Potential Volume of Debris Flows Post-Wildfire



Source: NWCG Incident Information System

Figure 4-5: USFS Waldo Canyon Probability of Debris Flows Post Wildfire



Source: NWCG Incident Information System

National Flood Insurance Program

There were 2,328 flood insurance policies in force in Colorado Springs as of May 2015. In 2009, there were 1,067 active policies showing an almost 120% increase in participation from 2009 to 2015. The number of major events in Colorado Springs from 2010 to 2015 and the level of effort by OEM in the recovery from these events along with increased risk of flooding downstream from the Waldo Canyon burn scar is likely a major catalyst for increased NFIP participation.

Table 4-6: NFIP Status for Colorado Springs

Jurisdiction	Date Joined	Effective FIRM Date	Policies in Force	Insurance in Force ($)	Number of Claims (Total/Closed)	Claims Total ($)
Colorado Springs	12/18/86	3/17/97	2,328	$534,204,000	342/173	$1,347,145

Source: National Flood Insurance Program Community Status Book Report, http://www.fema.gov/cis/CO.html, and NFIP Policy and Claim Statistics, https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13 , accessed May 2015.

The NFIP also tracks repetitive loss properties throughout the United States. According to their database, there are two repetitive loss properties in the City of Colorado Springs as of June 15, 2015. Digital Flood Insurance Rate Maps (DFIRMs) are currently being prepared for Colorado Springs and preliminary maps may be available during the summer of 2015. Effective maps are expected to become available in 2016.

Community Rating System

Colorado Springs participates in the CRS Program of the NFIP. This program is an incentive program developed by the NFIP to raise awareness of flood insurance, promote accurate insurance ratings, and ultimately reduce flood losses. The City of Colorado Springs holds a current class rating of 6 as of May 1, 2015[14]. This means that properties within Special Flood Hazard Areas (SFHA) are eligible for a 20% discount on flood insurance policies and properties outside the SFHA are eligible for a 10% discount. The highest achievable rating is a 1, where SFHA properties are eligible for a 45% discount on flood insurance policies. The lowest rating is a 10, where the community is not participating. At the time of the 2010 Plan, the City had a rating of 8 showing significant advancement from 2010 to 2015.

There are 18 creditable activities within four categories to increase a jurisdiction's rating. The categories include: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness. The City of Colorado Springs, through the PPRBD as the Floodplain Administrator, will continue to seek more CRS points to improve its rating to a Class 5 which would result in a discount of 25% for properties in the SFHA. Where possible, actions that would help the City meet additional CRS credible activities and help lower flood risk are incorporated in the 2016 Plan.

Probability of Future Occurrence

Typical Flood

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less.*

Significant Flood

Occasional: *1-10% chance of occurrence in the next year or a recurrence interval of 11 to 100 years.*

When taken literally, the 500-year flood event should occur once every 500 years, or have a 0.2% chance of occurring in any given year. The 100-year flood event should occur once every 100 years, or have a 1% chance of occurring in any given year. Based on historical data for previous occurrences in Colorado Springs, there were 59 flooding events that occurred within a

[14] FEMA Community Rating System website, http://www.fema.gov/media-library-data/1424450651900-d381a14283db10e28ae624543a9526ad/20_crs_508_apr2015.pdf, accessed June 29, 2015.

151-year period. This equates to a probability of 39% that a flood will occur in any given year, or that a flood will occur approximately once every 3 years. Typical flooding events in Colorado Springs flood streets, cause stream bank erosion, disable automobiles, and cause limited damage to property. The likelihood of a more significant flood such as a 50- or 100-year flood is far less than the typical flood.

Climate Change Impacts

Future climate scenarios show a warmer and drier climate in Colorado with occasional extreme precipitation which could lead to heightened flash flooding events. The draft 2015 Colorado Resiliency Framework states the following about future flood risk:

> *The Colorado Water Conservation Board has examined how water resources will be impacted by climate change through a number of studies including: Climate Change in Colorado, The Colorado River Water Availability Study, The Joint Front Range Climate Change Vulnerability Study, the Colorado Drought Mitigation and Response Plan, and the Colorado River Basin Water Supply and Demand Study.*
>
> *Based on these studies, the most likely impact of future climate change on water supplies is a shift in the timing of runoff. Projections indicate that runoff timing will shift 1 to 3 weeks earlier by mid-century, due to increased temperatures. This may affect flooding; it is also likely to result in decreased late summer streamflow. This is because of both increased temperatures and the projection that precipitation will generally increase in the winter months, and decrease in the summer months.*

At this time, there is no evidence that flooding will increase or decrease in the future. Some parts of the country are expected to be impacted by extreme precipitation events in the future but there is no statistically significant trend of that occurring in the future in Colorado according to the CWCB's 2014 *Climate Change in Colorado*.

Magnitude/Severity

Typical Flood

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours.*

Significant Flood

Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours.*

Most flooding events in Colorado Springs have caused property damage, flooded roadways, and stalled vehicles. This damage is fairly limited in magnitude, as services are interrupted for brief periods, and there are few if any injuries. However, extreme flooding events, such as the floods of 1935, are devastating. Multiple lives can be lost due to flash floods and/or slope failures. Multiple homes and businesses could be destroyed, and essential services could be compromised for long periods of time.

Figure 4-6: Memorial Day Flood of 1935, View from West Colorado Avenue

Source: Pikes Peak Library District Special Collections Photo Archives, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=001-4599-di-72.jpg;&view=1, accessed on November 30, 2009.

Vulnerability Assessment

Overall Summary and Impacts: Based on the Hazus modeling used for this 2016 Plan, the 100-year flood event would result in losses of $705,800,000 including building damage, contents, and building-based income losses such as rent. It is estimated that 1,472 structures would be damaged in the 100-year flood event.

For the 500-year event, the losses are estimated at $978,750,000. The estimated damaged structure count for this event is 1,986.

For the 10-year event, the losses are estimated at $424,430,000. The estimated damaged structure count for this event is 875.

For the 2-year event, the losses are estimated at $167,840,000. The estimated damaged structure count for this event is 285. The total damaged square footage of buildings is summarized by occupancy in the following table.

Table 4-7: Damage Summary by Building Occupancy (Percentage of total building square footage damaged)

Occupancy Type	Percentage of Total Damaged Building Square Footage			
	2-year flood	10-year flood	100-year flood	500-year flood
Agriculture	0.74%	0.85%	0.69%	0.57%
Commercial	26.19%	21.75%	24.27%	25.13%
Industrial	9.25%	9.36%	6.21%	6.22%
Residential	60.13%	65.20%	65.59%	65.15%

Occupancy Type	Percentage of Total Damaged Building Square Footage			
	2-year flood	10-year flood	100-year flood	500-year flood
Religion	2.10%	1.50%	1.58%	1.77%
Education	0.86%	0.72%	0.73%	0.74%
Government	0.73%	0.62%	0.63%	0.43%
Total Percentage	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Total Damaged Square Feet	**2,197,020**	**5,281,980**	**8,215,502**	**10,844,540**

Identifying Structures and Estimating Potential Losses (Hazus Results): To model the floodplains, and subsequently estimate the damage associated with a particular event, Hazus software requires a defined region. For this study, we wanted results at the census block level; therefore the region was defined by all census blocks within the City of Colorado Springs. Because census blocks are not aligned with city boundaries, the modeled region is larger than the City. Therefore, the estimated damage may be slightly skewed. The modeled flood region is shown in Figure 4-7. Figure 4-8 and Figure 4-9 show the modeled floodplains resulting from the Hazus analysis. The modeled flood region is 281 square miles, and contains 11,108 census blocks. The region, according to 2010 Census Bureau Data, contains over 173,000 households and has a total population of 431,766 people. There are an estimated 154,787 buildings in the region with a total building replacement value (excluding contents) of $47,174,000,000 (2013 dollars). Approximately 91% of the buildings and 79% of the building values are associated with residential uses.

Figure 4-10 shows the modeled floodplains resulting from the Hazus analysis for those streams impacted by flood after fire.

The floodplains resulting from the Hazus flood modeling analysis are illustrated in a series of map tiles in Appendix E: Flood Hazard Modeling Results.

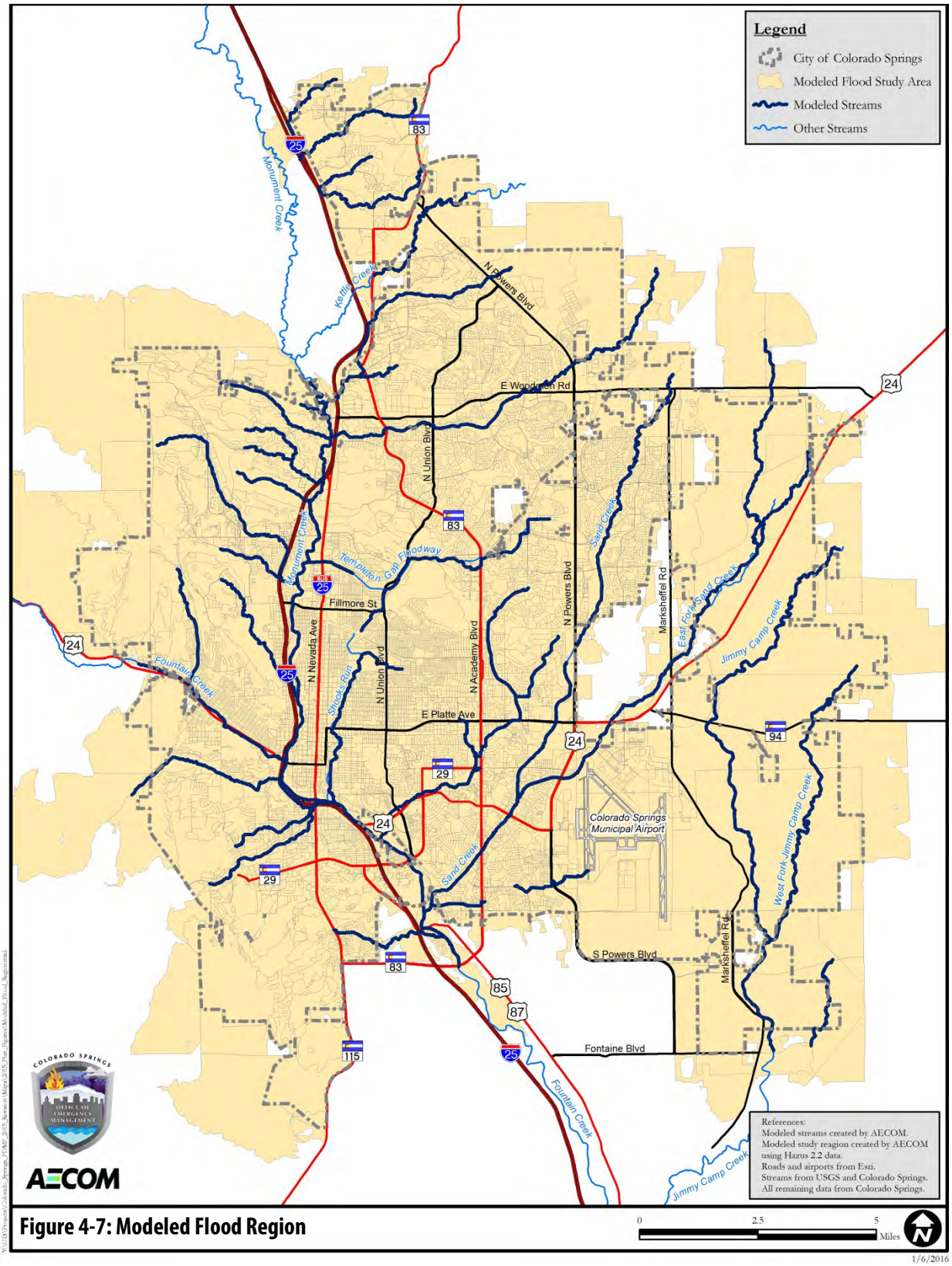


Figure 4-7: Modeled Flood Region

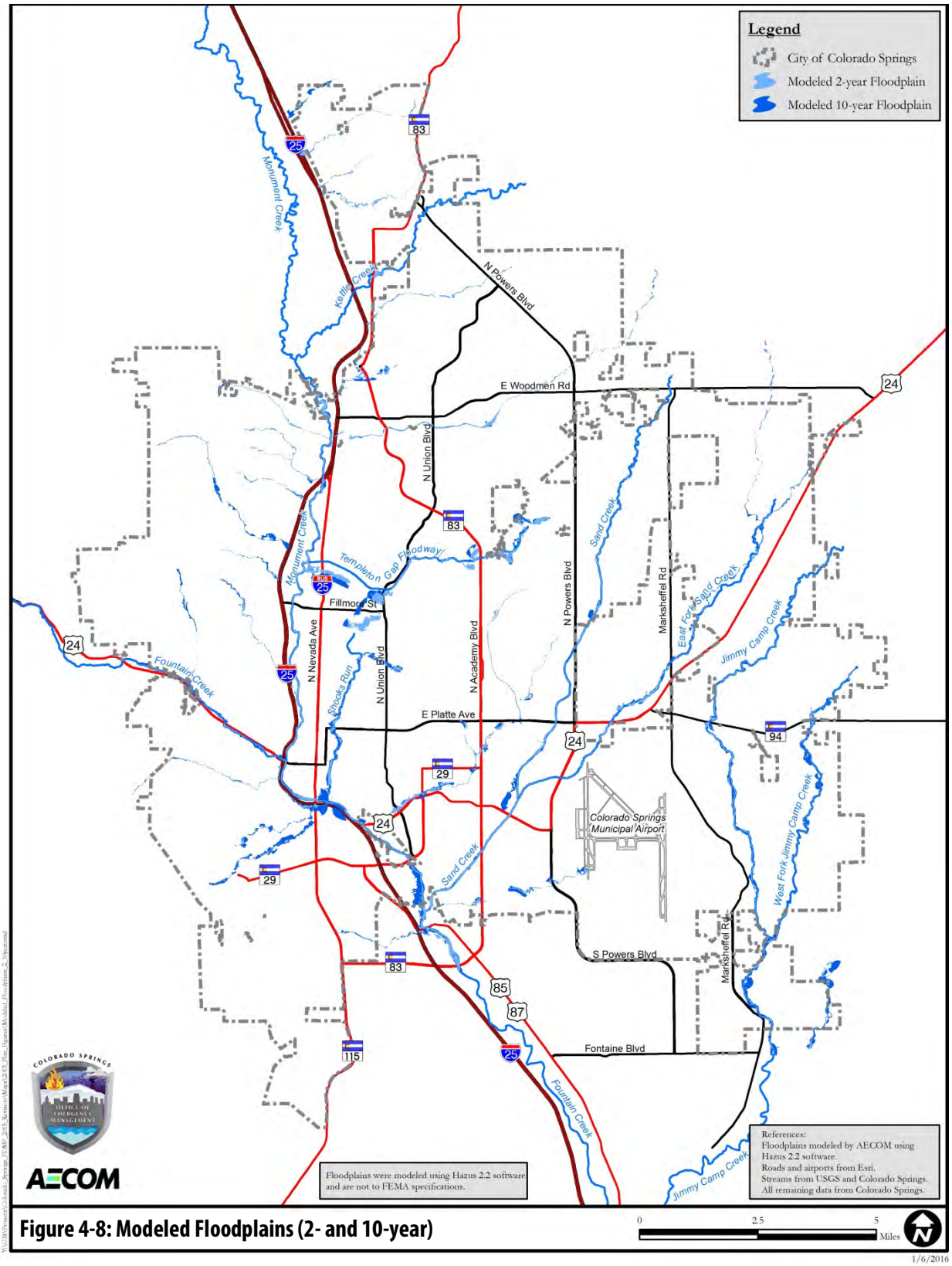


Figure 4-8: Modeled Floodplains (2- and 10-year)

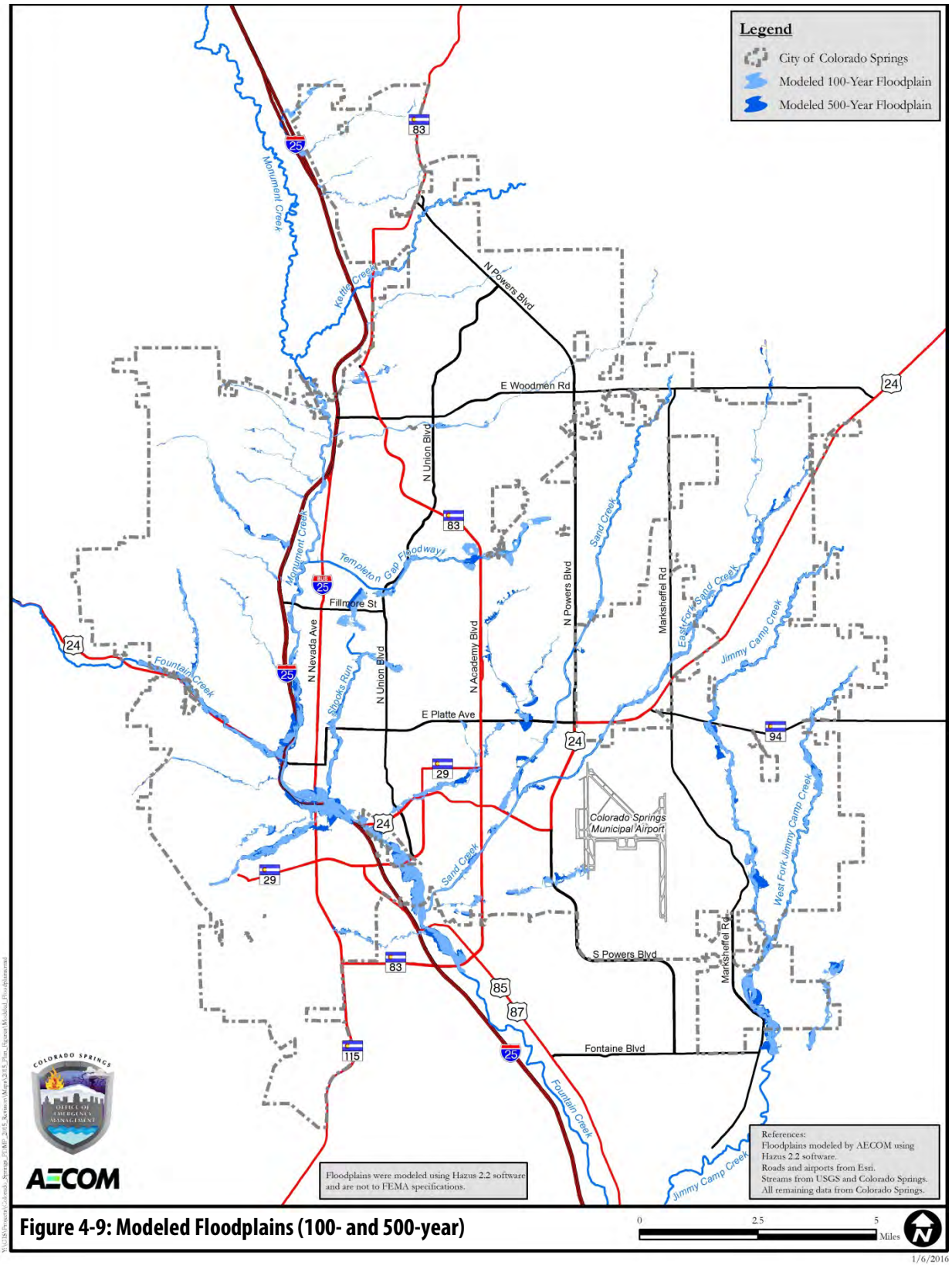


Figure 4-9: Modeled Floodplains (100- and 500-year)

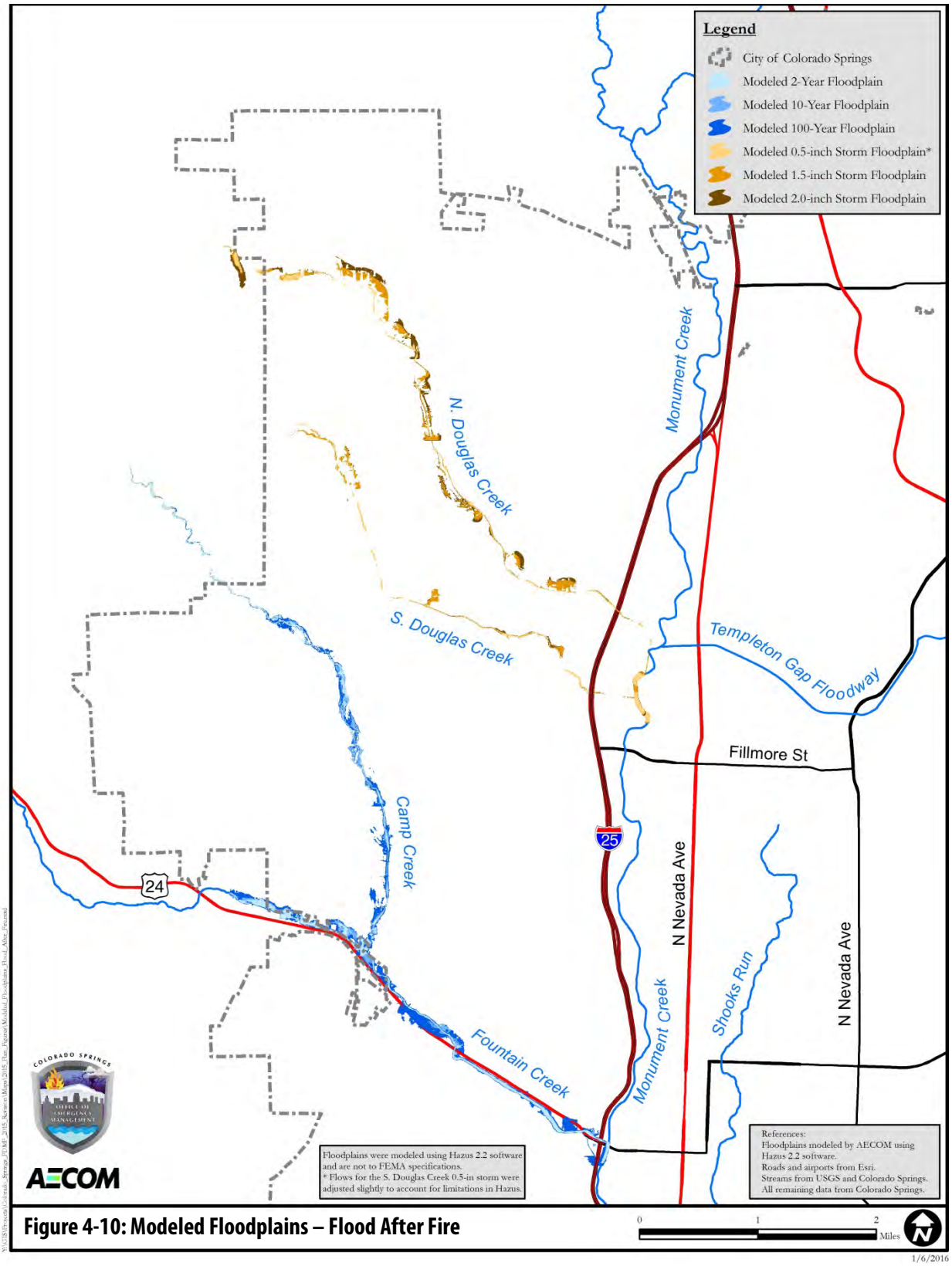


Figure 4-10: Modeled Floodplains – Flood After Fire

Hazus provides reports on the number of buildings impacted, building repair costs, and the associated loss of building contents and business inventory. Building damage can also cause function losses to a community, which relate to the opportunity loss of being able to use a building. Income loss data accounts for business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses. These losses are calculated by Hazus using a methodology based on the building damage estimates. Flood damage is directly related to the depth of flooding. For example, a two-foot flood results in approximately 20% of the structure being damaged (which translates to 20% of the structure's replacement value).

Table 4-8: Structures Damaged During Modeled Flood Events

Event	Number of Structures in Floodplain	Number of Structures Damaged	% of Total Structures in Modeled Region
2-year	605	285	0.2 %
10-year	1,508	875	0.6 %
100-year	2,386	1,472	1.0 %
500-year	2,993	1,986	1.3 %

Table 4-9: Damage Estimates and Economic Losses for Modeled Flood Events (2013 Dollars)

Damage Type	2-year	10-year	100-year	500-year
Building Damage	$70,760,000	$188,030,000	$318,210,000	$438,870,000
Contents Damage	$94,290,000	$229,820,000	$377,720,000	$525,590,000
Inventory Loss	$2,350,000	$5,470,000	$7,740,000	$11,220,000
Income Loss	$110,000	$270,000	$600,000	$870,000
Relocation Loss	$40,000	$130,000	$230,000	$360,000
Rental Income Loss	$0	$40,000	$100,000	$180,000
Wage Losses	$290,000	$670,000	$1,200,000	$1,660,000
TOTAL LOSSES	**$167,840,000**	**$424,430,000**	**$705,800,000**	**$978,750,000**

Table 4-10: Expected Square Footage (sf) Damaged, 2-year event

Occupancy	Percent damaged (sf) 1-10%	11-20%	21-30%	31-40%	41-50%	Substantially
Agriculture	3,232	7,969	3,469	729	325	486
Commercial	107,084	337,221	64,270	42,169	14,202	10,359
Industrial	9,558	70,852	49,300	37,154	20,899	15,572
Residential	48,703	208,254	571,264	172,346	153,779	166,807
Religion	14,040	31,741	133	57	63	205
Education	14,357	3,739	319	73	70	230
Government	3,732	12,251	9	0	0	0
TOTAL (sf)	**200,705**	**672,026**	**688,764**	**252,527**	**189,340**	**193,658**

Table 4-11: Expected Square Footage (sf) Damaged, 10-year event

Occupancy	Percent damaged (sf) 1-10%	11-20%	21-30%	31-40%	41-50%	Substantially
Agriculture	6,857	9,824	6,995	4,506	3,553	2,790
Commercial	489,727	695,698	185.996	98,725	54,834	30,324
Industrial	15,301	140,984	17,905	79,501	45,734	35,496
Residential	82,583	464,409	1,501,890	488,272	524,487	376,153
Religion	13,813	77,625	320	128	183	355
Education	32,780	6,962	561	140	79	277
Government	7,431	13,256	7,310	3,815	268	24
TOTAL (sf)	**348,492**	**1,408,757**	**1,775,077**	**675,087**	**629,141**	**445,419**

Table 4-12: Expected Square Footage (sf) Damaged, 100-year event

Occupancy	Percent damaged (sf) 1-10%	11-20%	21-30%	31-40%	41-50%	Substantially
Agriculture	6,064	20,011	11,003	8,402	4,877	6,299
Commercial	262,561	1,070,640	272,694	167,337	120,396	124,607
Industrial	23,529	159,432	83,514	81,312	81,260	80,876
Residential	121,602	653,054	2,086,379	797,924	1,005,084	724,837
Religion	23,017	88,820	5,764	2,481	3,968	5,916
Education	43,870	11,878	1,930	876	450	859
Government	14,040	17,307	5,285	5,293	3,236	6,848
TOTAL (sf)	**494,683**	**2,021,140**	**2,466,569**	**1,063,625**	**1,219,271**	**950,241**

Table 4-13: Expected Square Footage (sf) Damaged, 500-year event

Occupancy	Percent damaged (sf) 1-10%	11-20%	21-30%	31-40%	41-50%	Substantially
Agriculture	7,033	17,641	11,740	5,129	6,681	13,418
Commercial	289,290	1,388,945	400,066	221,490	146,205	279,545
Industrial	24,808	193,219	125,491	95,621	86,227	148,938
Residential	191,846	794,708	2,578,241	1,147,192	1,339,228	1,014,019
Religion	40,124	120,097	7,298	3,176	4,411	16,328
Education	53,815	17,059	3,552	1,631	1,270	2,398
Government	5,449	17,288	5,458	4,546	4,007	9,925
TOTAL (sf)	**612,366**	**2,548,956**	**3,131,845**	**1,478,785**	**1,588,028**	**1,484,571**

Mapping sets for each of the modeled flood scenarios showing buildings and critical facilities are included in Appendix E. Table 4-14, shows the estimated losses for each flood scenario on each stream based on the Hazus modeling. Some of the results in

the table may be inflated due to unavoidable double-counting based on overlapping watersheds. Hazus estimates losses based on census block aggregate data; therefore, there are instances where multiple modeled streams may include losses from one census block. If a flood scenario (floodplain polygon) intersects a census block, it will count the aggregate losses for that census block for that particular event.

Table 4-14: Losses by Modeled Stream – Hazus Estimates

Stream Name	Hazus Estimated Losses ($ Dollars, 2013)*			
	2-year	10-year	100-year	500-year
Bear Creek	4,959,000	5,055,000	4,679,000	13,902,000
Black Squirrel Creek	2,849,000	286,000	1,917,000	2,148,000
Camp Creek	210,000	461,000	2,641,000	6,283,000
Cheyenne Creek	8,097,000	51,257,000	81,769,000	114,232,000
Cheyenne Run	5,802,000	17,395,000	22,800,000	27,560,000
Cottonwood Creek	13,521,000	15,382,000	34,771,000	28,256,000
Douglas Creek North	1,479,000	25,235,000	31,051,000	43,229,000
Douglas Creek South	2,164,000	5,042,000	7,511,000	7,093,000
Dry Creek	5,562,000	7,114,000	8,099,000	10,372,000
Fishers Canyon	3,654,000	17,736,000	13,105,000	24,348,000
Fountain Creek	15,459,000	95,161,000	125,162,000	225,983,000
Jimmy Camp Creek	33,000	370,000	1,020,000	1,212,000
Jimmy Camp Creek Corral Tributary	0	3,000	8,000	10,000
Jimmy Camp Creek East Tributary	6,000	186,000	235,000	289,000
Kettle Creek	3,027,000	1,967,000	3,721,000	5,251,000
Mesa Creek	7,512,000	7,453,000	6,255,000	6,081,000
Middle Tributary	1,296,000	1,659,000	1,832,000	1,242,000
Monument Branch	1,422,000	1,729,000	2,329,000	1,989,000
Monument Creek	50,022,000	71,507,000	113,766,000	179,940,000
North Rockrimmon Creek	34,582,000	18,414,000	12,065,000	17,061,000
Peterson Field	3,364,000	15,066,000	17,748,000	19,760,000
Pine Creek	20,703,000	20,320,000	37,132,000	40,142,000
South Rockrimmon Creek	8,496,000	9,115,000	15,328,000	28,515,000
Sand Creek	42,837,000	76,400,000	118,042,000	200,624,000
Shooks Run	6,677,000	34,537,000	55,241,000	66,739,000
Smith Creek	0	2,647,000	3,206,000	3,872,000
Spring Creek	17,958,000	21,809,000	41,474,000	51,664,000
Templeton Gap Floodway	90,979,000	118,078,000	126,486,000	118,613,000
Upper (West) Fountain Creek	5,223,000	11,063,000	47,527,000	69,646,000
Woodmen Valley	641,000	556,000	1,032,000	1,463,000
TOTALS *	**358,534,000**	**653,003,000**	**937,952,000**	**1,317,519,000**

*Hazus estimates losses based on census block aggregate data, therefore there are instances where multiple modeled streams may include losses from one census block. If a flood scenario (floodplain polygon) intersects a census block, it will count the aggregate losses for that census block for that particular event. Those streams in bold indicate that the results are skewed due to the digital elevation model.

Table 4-15 shows the estimated losses for those streams impacted by flood after fire. As with the flood scenario results presented above, some of the results in the table may be inflated due to double-counting. Due to the availability of reference information used in the Hazus analysis, results for Camp Creek and Fountain Creek are based on the estimated flood frequency, while the results for North and South Douglas Creeks are based on the estimated rainfall amount that would occur in a 2-hour period.

Table 4-15: Losses by Modeled Stream, Streams Impacted by Flood after Fire – Hazus Estimates

	Hazus Estimated Losses ($ Dollars, 2013)*					
Stream Name	**2-year**	**10-year**	**100-year**	**0.5 inch**	**1.5 inch**	**2.0 inch**
Camp Creek	999,000	2,234,000	7,772,000	na	na	na
Fountain Creek	5,497,000	10,398,000	27,763,000	na	na	na
North Douglas Creek	na	na	na	5,965,000	24,640,000	32,429,000
South Douglas Creek	na	na	na	3,474,000**	5,788,000	6,438,000
TOTALS *	**6,496,000**	**12,632,000**	**35,535,000**	**9,439,000**	**30,428,000**	**38,867,000**

* Hazus estimates losses based on census block aggregate data, therefore there are instances where multiple modeled streams may include losses from one census block. If a flood scenario (floodplain polygon) intersects a census block, it will count the aggregate losses for that census block for that particular event.
** Due to limitations within Hazus, flows for the S. Douglas Creek 0.5-in storm were increased approximately 35% so the stream could be modeled.

Critical Facilities and Infrastructure: According to the census data included in the Hazus software, there are multiple essential facilities located within the defined Hazus region, including five hospitals, 189 schools, 15 fire stations, 13 police stations, and one Emergency Operations Center (EOC). Expected damage to essential facilities is described in Table 4-16.

Table 4-16: Essential Facility Damages, Hazus Flood Results 100-year event

Facility Type	Total Number of Facilities in the City (from Hazus)	Number of Damaged Facilities 2-year	Number of Damaged Facilities 10-year	Number of Damaged Facilities 100-year	Number of Damaged Facilities 500-year
Fire Stations	15	0	0	0	0
Hospitals	5	0	0	0	0
Police Stations	13	0	2	0	0
Schools	189	0	3	8	8

Table 4-17 summarizes the Hazus estimates for shelter requirements following major flood events in the modeled region.

Table 4-17: Shelter Requirements Following Major Flood

Event	Households Displaced	Population Seeking Shelter
2-year	1,372	2,157
10-year	3,026	6,326
100-year	4,503	9,902
500-year	5,528	12,495

Identifying Structures and Estimating Potential Losses (Parcel Analysis): Using GIS overlay tools the team performed a parcel and building analysis using the City of Colorado Springs parcel and buildings data compared with the floodplains

generated through the Hazus modeling software. The results in Table 4-18 are specific to the City of Colorado Springs, rather than the region defined for the model.

Table 4-18: Summary of Parcel and Building Analysis – Flooding in Colorado Springs

Category	2-year	10-year	100-year	500-year
Parcels in Floodplain	4,160	5,139	6,963	8,512
Buildings in Floodplain	1,599	3,656	6,107	8,160
Market Value of Parcels in Floodplain	$2,105,992,476	$2,561,820,243	$2,986,662,483	$3,278,562,951

There are 8,160 buildings on 8,512 parcels in the City of Colorado Springs that intersect the 500-year floodplain and are therefore vulnerable to damage. The market value of these parcels is nearly $3.3 billion, which is over 9% of the total market value of all parcels in the City of Colorado Springs.

Table 4-19: Number of Buildings Located within Each Floodplain by Modeled Streams

	Number of Buildings within Modeled Floodplains			
Stream Name	2-year	10-year	100-year	500-year
Bear Creek	0	3	8	12
Black Squirrel Creek	2	0	2	1
Camp Creek	12	9	76	216
Cheyenne Creek	66	465	776	947
Cheyenne Run	25	115	133	178
Cottonwood Creek	4	7	13	16
Douglas Creek North	11	122	205	247
Douglas Creek South	5	6	18	21
Dry Creek	0	7	8	26
Fishers Canyon	42	74	139	314
Fountain Creek	11	138	1,011	1,354
Jimmy Camp Creek	0	0	4	6
Kettle Creek	4	7	7	12
Mesa Creek	3	6	9	21
Middle Tributary	2	2	2	1
Monument Branch	17	17	26	28
Monument Creek	0	3	134	355
North Rockrimmon Creek	3	6	11	22
Peterson Field	111	306	507	540
Pine Creek	19	23	25	34
South Rockrimmon Creek	1	1	1	1
Sand Creek	62	257	599	1,383
Shooks Run	128	405	528	626
Spring Creek	22	54	79	112
Smith Creek*	N/A	3	4	5

Stream Name	Number of Buildings within Modeled Floodplains			
	2-year	10-year	100-year	500-year
Templeton Gap Floodway (Hazus)**	1,021	1,399	1,368	1,206
Templeton Gap Floodway (FEMA Q3 Data)**	N/A	N/A	123	337
Upper (West) Fountain Creek	28	221	414	476
Woodmen Valley	0	0	0	0
TOTALS* **	**1,599**	**3,656**	**6,107**	**8,160**

*Due to limitations in Hazus, Smith Creek was not modeled for the 2-year event.

**For the Templeton Gap Floodway, modeling anomalies resulted in inaccurate floodplains based on the digital elevation model. For this reason, FEMA-provided Q3 floodplain data were used to estimate the number of structures (available only for 100- and 500-year events).

***Totals include Hazus analysis only, not FEMA-provided data for Templeton Gap Floodway.

Table 4-20: Estimated Market Values within Each Floodplain by Modeled Streams

Stream Name	Estimated Market Value of Parcels within Floodplain ($ U.S. Dollars, 2013)			
	2-year	10-year	100-year	500-year
Bear Creek	$6,422,683	$6,422,683	$6,422,683	$7,922,747
Black Squirrel Creek	$529,883,279	$528,248,358	$528,864,494	$529,106,117
Camp Creek	$4,891,290	$5,970,764	$45,672,333	$60,761,140
Cheyenne Creek	$50,434,286	$102,091,077	$141,535,549	$169,069,882
Cheyenne Run	$50,011,516	$70,689,314	$75,111,063	$88,590,647
Cottonwood Creek	$36,680,086	$57,528,775	$67,436,011	$69,179,419
Douglas Creek North	$8,151,335	$79,681,610	$107,083,190	$109,035,115
Douglas Creek South	$16,303,775	$18,404,137	$27,179,205	$27,243,321
Dry Creek	$13,755,220	$16,637,089	$30,817,261	$37,577,650
Fishers Canyon	$5,955,303	$24,982,939	$30,607,667	$47,147,401
Fountain Creek	$92,288,213	$109,664,313	$133,035,933	$166,263,014
Jimmy Camp Creek	$312,588	$6,749,896	$18,473,085	$18,905,515
Jimmy Camp Creek Corral Tributary	N/A	$119,282	$119,282	$119,282
Jimmy Camp Creek East Tributary	N/A	$939,300	$939,300	$486,100
Kettle Creek	$532,059,011	$532,989,051	$533,895,484	$534,283,554
Mesa Creek	$5,914,442	$8,100,530	$9,366,678	$15,383,752
Middle Tributary	$44,462,269	$45,092,069	$45,455,237	$45,985,843
Monument Branch	$48,281,418	$53,811,403	$54,656,871	$57,069,593
Monument Creek	$64,638,506	$88,990,791	$159,988,222	$184,871,101
North Rockrimmon Creek	$16,260,319	$32,306,726	$33,957,756	$49,074,051
Peterson Field	$37,531,405	$49,254,554	$63,164,726	$58,648,021
Pine Creek	$120,177,678	$127,675,135	$139,138,729	$148,162,800
South Rockrimmon Creek	$4,361,812	$3,752,203	$4,361,812	$4,361,812
Sand Creek	$81,731,779	$194,896,404	$262,053,399	$412,881,839
Shooks Run	$36,461,328	$72,355,042	$83,717,296	$91,012,687
Smith Creek*	N/A	$625,666	$1,098,048	$625,666

Stream Name	Estimated Market Value of Parcels within Floodplain ($ U.S. Dollars, 2013)			
	2-year	10-year	100-year	500-year
Spring Creek	$44,168,684	$49,778,400	$61,727,400	$83,486,760
Templeton Gap Floodway (Hazus)**	$234,830,748	$249,961,659	$275,164,564	$208,782,892
Templeton Gap Floodway (FEMA Q3 Data)**	N/A	N/A	$81,587,682	$123,806,762
Upper (West) Fountain Creek	$16,703,844	$20,781,414	$42,299,546	$49,205,571
Woodmen Valley	$3,319,659	$3,319,659	$3,319,659	$3,319,659
TOTALS* **	**$2,105,992,476**	**$2,561,820,243**	**$2,986,662,483**	**$3,278,562,951**

*Due to limitations in Hazus, Smith Creek was not modeled for the 2-year event.
**For the Templeton Gap Floodway, modeling anomalies resulted in inaccurate floodplains based on the digital elevation model. For this reason, FEMA-provided Q3 floodplain data were used to estimate the market value of parcels (available only for 100- and 500-year events).
***Totals include Hazus analysis only, not FEMA-provided data for Templeton Gap Floodway.

Based on the improved use field from the assessor's database, there are an estimated 6,262 residential uses within the 500-year floodplain that could be potentially damaged during a major flood event. When multiplied by 2.5 persons per household, this equates to an estimated possible displaced population of 15,655 people. This is approximately 3.6% of the total estimated population of Colorado Springs in 2010 (431,766). This is different from the population seeking shelter in the Hazus results because the parcel analysis assumed 2.5 persons per household and was based on the parcel rather than the census block aggregate data used by Hazus. Table 4-21, below, summarizes the potential shelter requirements for each flood scenario.

Table 4-21: Potential Shelter Requirements Following Flood (based on Parcel Analysis)

Event	Potential Households Displaced	Potential Population Seeking Shelter
2-year	2,067	5,168
10-year	3,446	8,615
100-year	5,033	12,583
500-year	6,262	15,655

Impacts of Flood on the Colorado Springs Economy and Tax Base: Disruption of the local economy is an anticipated consequence of major flooding and wildfire that impact Colorado Springs. Although these events may cause building and infrastructure damage, the most detrimental short-term impact is caused by the loss of electric power which would impact businesses, government operations and residents. Without a relatively quick restoration of services, small businesses could close.

Colorado Springs is susceptible to economic disruption because the primary industries are related to retail sales, service, and tourism. With over 300 days of sunshine; nearby mountains with multiple recreational and tourist opportunities; over 55 local attractions such as Pike's Peak, the Garden of the Gods Park, and the U.S. Olympic Training Center; and abundant history, Colorado Springs receives an estimated 5.2 million visitors annually[15]. Events that cause visitors to stay away, such as a major wildfire or flood, would result in economic loss to local businesses and loss of tax income to the City.

[15] Visit Colorado Springs website at http://www.visitcos.com/fast-facts, accessed July 6, 2015

Major disasters can create a "domino effect" that can hurt the economy. For example, major damage and loss to residential properties can lead to displacement of people. A decrease in population means loss of clientele for local businesses. Businesses may be destroyed or damaged to the degree that they cannot operate (whether short- or long-term). Even without initial major population relocation, business closings can contribute to reduced services, leading some to relocate in the short-term. Business closings and destruction or severe damage of facilities such as schools, libraries, and other public buildings may eliminate jobs (even in the short term) and may lead some people to leave the area.

Impacts of Flood on Public Health in Colorado Springs: Extended exposure of buildings to floodwaters can cause mold growth which thrives in moist conditions. If mold growth is not treated properly it can cause serious health conditions, especially for people with breathing difficulty. Saturation of building materials and contents can cause mold growth. All flooded materials must be dried thoroughly after a flood event to reduce the chance of mold growth and protect the health of occupants.

Life, safety, health, procedures for warning and evacuation: Flash flooding is a great concern in Colorado Springs, since the Waldo Canyon Fire. Extensive efforts have been taken to prepare residents for the risk, including Flood Preparedness meetings. Maps on the City's website (https://oem.coloradosprings.gov/public-safety/emergency-management/local-weather-hazards/flash-flooding) provide beneficial information about flash flood watches and warning as well as a brochure and recording of a flood preparedness meeting[16]. The website describes the three different levels of warnings:

- An urban and small stream advisory means that isolated flooding of streams, streets, and low-lying areas, such as railroad underpasses and urban storm drains is occurring.
- A flash flood watch means that flash flooding is possible. Be alert and prepared to move to high ground. Watch for rising water levels or unusual street flooding.
- A flash flood warning means that a flash flood is occurring or is about to occur. If necessary relocate immediately and seek high ground away from high risk areas and water.

This website also provides detailed information on how to prepare for a flash flood, including where to get warnings, and steps to take during a flood.

Areas that Provide the Natural Floodplain Functions: Floodplains along the Front Range of Colorado are generally narrow and in areas with large changes in grade. Creeks that run through cities like Colorado Springs are relatively small and quickly become full when heavy rainfall occurs upstream. Generally, these streams also have high levels of sedimentation. For Colorado Springs, the sedimentation generally includes decomposed granite in the steep sloped watersheds or sand in the watersheds of the rolling plains. Wherever possible, lands adjacent to streams should be preserved and maintained for recreational purposes to preserve as much area for the natural floodplains to perform their function of storing and absorbing flood waters.

Secondary Impacts: As noted in Table 2 in the 2015 Colorado State Emergency Operations Plan (SEOP), flood as the original event can trigger secondary or cascading impacts that exacerbate risk from other hazards. Excessive rainfall in a short period of time can create flood conditions as well as create pressure on dams that lead to failure. Floods can also cause subsidence and

[16] From Colorado Springs OEM website at https://oem.coloradosprings.gov/public-safety/emergency-management/local-weather-hazards/flash-flooding, accessed July 6, 2015

trigger a hazardous materials (HAZMAT) incident if there is a fixed or mobile source of hazardous materials in the flood inundation area. A dam failure could also cause mass casualties and impact transportation, trigger urban fires, and cause utility disruption.

Future Development:

The majority of development in Colorado Springs will occur in large open spaces to the east and northeast of town. No new structure can be built in the floodway portion of a flood zone. Structures in the flood zone that are damaged more than 49% must comply with regulations that require floodproofing or elevation as a means of mitigation.

Future development is controlled by existing and forthcoming revised regulations but existing structures will be at risk unless removed from the flood area. The local government agencies have a regional Floodplain Administration Office that utilizes FEMA regulations as a baseline set of criteria and has added a number of other restrictions. The end result is a policy that seeks to reduce the damage and destruction that a flood can cause.

All activity in the floodplain is controlled by the Floodplain Administration Office, which is part of the Regional Building Department. The Floodplain Administration Office works with the U.S. Army Corps of Engineers with respect to permitting activities.

As regulations are improved there will be more restrictions placed on existing structures when owners want to extend their economic life, make additions, or otherwise perform some project.

The end result of the above regulation of activity in the floodplain is that there will never be large numbers of new projects or new structures that will be placed in the floodplain… If a development area is partly within a a floodplain, the area in the floodplain is a "no-build" area that must be permanently restricted from any building activity.

Figure 4-11: Floodplain Review and Permit Process

Pikes Peak Regional Building Department

FLOODPLAIN REVIEW & PERMIT PROCESS

If property is located in or near a FEMA designated floodplain:

SUBDIVISION PLAT	FLOODPLAIN ZONE	LAND REQUIREMENTS	LOMR	PLAT INFORMATION REQUIREMENTS
	A - Proposed development		LOMR prior to plat.	Show FEMA approved floodplain boundary and flood elevation.
	AE -Proposed lots in flood fringe	Floodplain permit to elevate lots; No new lots in floodplain.	LOMR prior to plat.	Show FEMA approved floodplain boundary and flood elevation.
	AE - Proposed lots in floodway	No new lots in floodplain.		Plat floodplain as a NO BUILD zone tract.
	AO - Proposed development	Fill lots.	LOMR prior to plat.	Show FEMA approved floodplain boundary and flood elevation.

SINGLE LOT	PROJECT TYPE	REQUIREMENTS	FLOODPLAIN PERMIT	ELEVATION CERTIFICATE
RESIDENTIAL	Remodel less than 50 percent	Flood proof techniques to minimize future flooding; Meet construction codes as applicable.	Required	Required
	Remodel more than 50 percent	Must meet new construction requirements.	Required	Required
	New construction	Lowest floor raised 1 foot above FEMA flood elevation; Meet all current construction code requirements.	Required	
	Exterior improvement*	Design to withstand flood or break-away. Proof of retaining system.	Required	
COMMERCIAL	Remodel less than 50 percent	Use flood proofing techniques to minimize flood impact; Meet all construction codes as applicable.	Required	Required
	Remodel more than 50 percent	Meet all current construction code requirements.	Required	Required
	New construction	Lowest floor raised 1 foot above flood elevation or flood proof; Meet all current construction code requirements.	Required	Required
	Exterior improvement*	Design to withstand flood, or design to break away in a flood event. Provide proof of retaining system.	Required	

* **Exterior improvements** include changes to property (such as fill, excavation, landscaping, retaining wall, fence) and to structures (such as roofing, siding, deck, shed, etc.)

Source: Pikes Peak Regional Building Department, www.pprbd.org, accessed on January 20, 2010. Link and graphic verified for 2016 Plan.

Data Limitations

Hazus is limited in its capabilities to census block data. This modeling software provides a less accurate estimate of the floodplain than the DFIRMs will, once approved by FEMA and made effective. For the next plan revision, Colorado Springs should incorporate the DFIRM data into the Hazus loss estimations.

4.3.2 Dam and Levee Failure

Hazard Description

Dams are manmade structures built for a variety of uses, including flood protection, power, agriculture, water supply, and recreation. Dams typically are constructed of earth, rock, concrete, or mine tailings. Two factors that influence the potential severity of a full or partial dam failure are the amount of water impounded and the density, type, and value of development and infrastructure located downstream. Dam failures can result from any one or a combination of the following causes: overtopping caused by floods that exceed the capacity of the dam, deliberate

acts of sabotage, structural failure of materials used in dam construction, movement and/or failure of the foundation supporting the dam, settlement and cracking of concrete or embankment dams, piping and internal erosion of soil in embankment dams, or inadequate maintenance and upkeep.[17]

Dams are classified based on the potential loss of life and property to the downstream area resulting from failure of the dam or facilities, not from the condition or probability of the dam failing:

- **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 and/or environmental losses; losses are principally limited to the owner's property

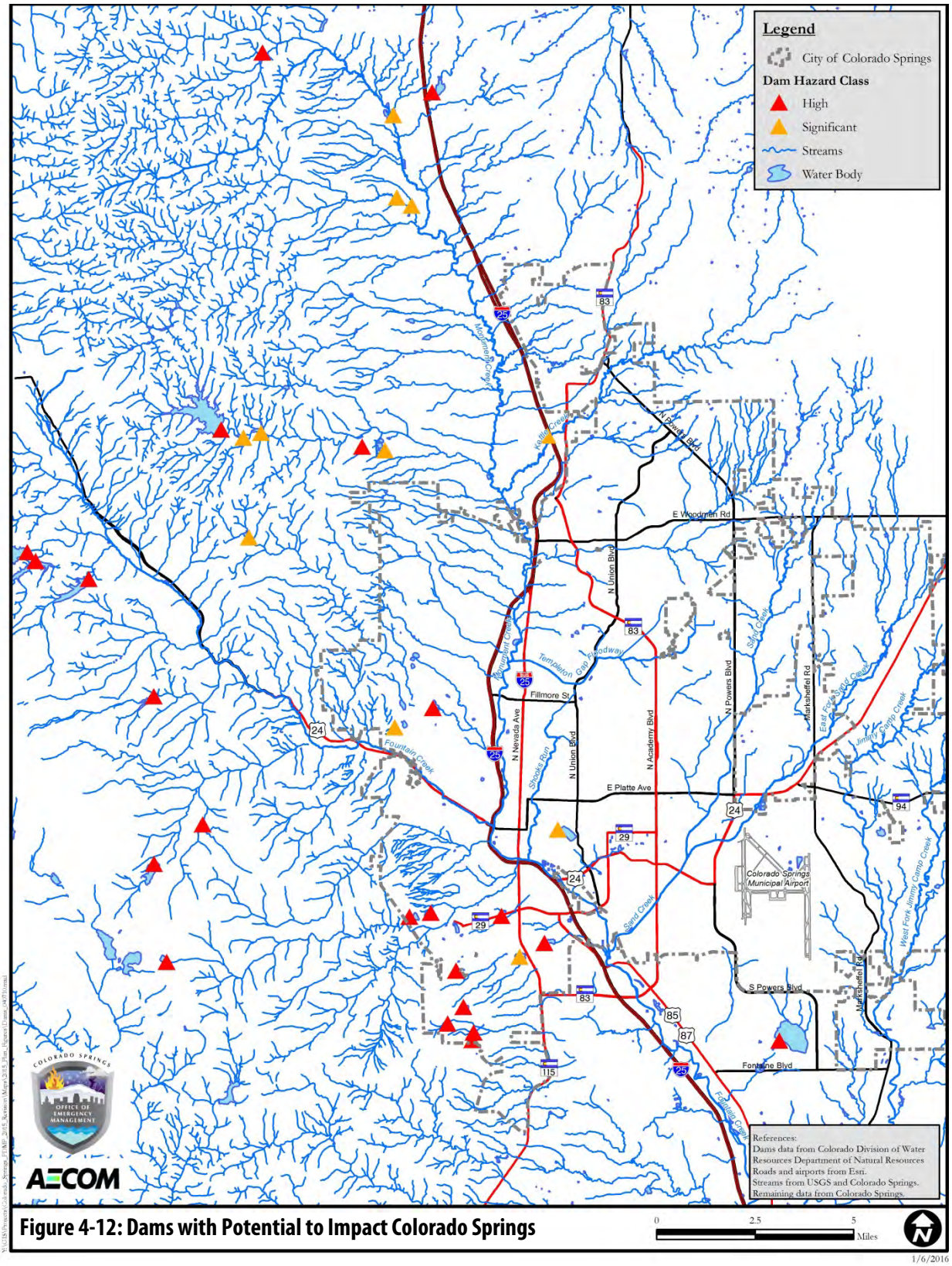
Levees are usually earthen embankments designed to contain, control, or divert the flow of water to provide some level of protection from flooding. Some levee systems were built for agricultural purposes and provide flood protection and flood loss reduction for farm fields and other land used for agricultural purposes. Urban levee systems are built to provide flood protection and flood loss reduction for population centers and the industrial, commercial, and residential facilities within them (FEMA 2009).

Levees are designed to provide a specific level of flood protection. Agricultural levee systems provide a level of protection that is appropriate based on the value of the assets being protected. Urban levee systems, because they are designed to protect urban areas, have typically been built to higher standards. No levee system provides full protection from all flooding events to the people and structures located behind it. Some level of flood risk exists in these levee-impacted areas (FEMA 2009).

Geographic Location

Of the known dams in El Paso County, 27 are classified as high hazard, 15 are classified as significant hazard, 79 as low hazard, and 45 as no public hazard. Of these dams, there are 33 dams that could potentially impact the City of Colorado Springs if the dam was breached as shown in Figure 4-12. Of these 33 dams, 21 are rated as high hazard potential by the State Department of Natural Resources – Dam Safety Branch. The other 11 dams are rated as a significant hazard potential.

[17] FEMA, Why Dams Fail, https://www.fema.gov/why-dams-fail, accessed June 2015


Legend
City of Colorado Springs
Dam Hazard Class
High
Significant
Streams
Water Body
Monument Creek
Kettle Creek
N Powers Blvd
E Woodmen Rd
N Union Blvd
Templeton Gap
Broadway
Fillmore St
N Nevada Ave
Shooks Run
N Academy Blvd
Fountain Creek
E Platte Ave
Sand Creek
Marksheffel Rd
Jimmy Camp Creek
Colorado Springs Municipal Airport
S Powers Blvd
Fontaine Blvd
References:
Dams data from Colorado Division of Water Resources Department of Natural Resources
Roads and airports from Esri.
Streams from USGS and Colorado Springs.
Remaining data from Colorado Springs.
AECOM
Figure 4-12: Dams with Potential to Impact Colorado Springs
0
2.5
5
Miles
1/6/2016

All dams with either a significant or high hazard potential are required to maintain an Emergency Action Plan (EAP). An EAP is defined as a plan of action to be taken to reduce the potential for property damage and loss of life in an area affected by a dam failure or large flood. Table 4-22 lists all the dams that could potentially impact the City of Colorado Springs.

Table 4-22: Dams with Potential to Impact City of Colorado Springs

Name	Hazard Classification	Inspection Date	Owner
Big Tooth	High	16-Jul-09	CSU
Crystal Creek	High	15-Oct-09	CSU
Fisher Canon	High	16-Nov-07	Cog Land and Development Co.
Fishers Canyon Debris Basin	High	12-Jul-07	Broadmoor Resort Community HOA
Fountain Valley No 2	High	12-May-09	Fountain Mutual Irrigation Co.
Gold Camp	High	25-Jun-09	CSU
Highline	High	19-May-09	CSU
Lake Moraine	High	16-Jul-09	CSU
Manitou	High	19-Oct-09	City of Manitou Springs
North Catamount	High	15-Oct-09	CSU
Palmer Lake #2	High	27-Jun-08	Town of Palmer Lake
Penrose	High	25-Jun-09	CSU
Rampart	High	10-Jun-09	CSU
Regulating Reservoir	High	13-Sep-07	CSU
South (Quail) Lake	High	16-Mar-10	City of Colorado Springs Parks and Recreation
South Catamount	High	15-Oct-09	CSU
South Suburban	High	25-Jun-09	CSU
Spires Broadmoor North Debris Dam	High	06-May-08	Spires Broadmoor Drainage HOA
Spires Broadmoor South Debris Dam	High	06-May-08	Spires Broadmoor Drainage HOA
Spring Run #2	High	12-Jul-07	Myron Stratton Home
Stratton	High	17-Sep-09	CSU
Woodmoor Lake	High	27-Jun-08	Woodmoor Water and Sanitation District No.1
Bristlecone	Significant	24-Jul-07	Forest Lakes Metro District
Curr	Significant	03-Nov-06	Country Club of Colorado
Kettle Creek	Significant	07-Apr-98	CH2M Hill Academy Services, LLC
McCullough	Significant	13-Sep-07	CSU
Monument Lake	Significant	17-Jul-07	Town of Monument
Nichols	Significant	09-Oct-08	CSU
Northfield	Significant	10-Jun-09	CSU
Palmer Lake #5	Significant	19-Oct-09	The Navigators/Eagle Lake Camp
Pinon	Significant	24-Jul-07	Forest Lakes Metro District
Prospect Lake	Significant	06-Nov-06	City of Colorado Springs Parks and Recreation
Valley No. 2	Significant	06-Sep-00	City of Colorado Springs Parks and Recreation

Source: Colorado Division of Water Resources, Department of Natural Resources, Dam Safety Branch April 2010. Verified for 2016 Plan.

There is only one levee in the City of Colorado Springs: the Templeton Gap Floodway. The Templeton Gap Floodway starts just east of Union Boulevard and heads west to Monument Creek past Nevada Avenue. Not only does the Templeton Gap Floodway prevent flood waters from overflowing into the adjacent properties; it also diverts flow from one drainageway to another. The Templeton Gap Floodway was constructed in 1949 by the USACE to divert flow away from downtown and into Monument Creek to the west. This 2 mile floodway project provides protection for 5,000 structures.[18] Figure 4-13 illustrates the geographic location of the Templeton Gap Floodway.

Figure 4-13: Templeton Gap Floodway Map

Source: City of Colorado Springs website, http://www.springsgov.com/Page.aspx?NavID=2743, accessed on December 4, 2009.
2016 Plan Update: Map no longer available on City's website.

[18] City of Colorado Springs website, Templeton Gap Floodway Project, https://coloradosprings.gov/resident-services/public-works/city-engineering/templeton-gap-floodway-project, accessed on February 9, 2016.

Figure 4-14: Photos of the Templeton Gap Floodway Project

Source: City of Colorado Springs website, Templeton Gap Floodway Project, http://www.springsgov.com/Page.aspx?NavID=2743, accessed on December 4, 2009. 2016 Plan Update: Link no longer operable.

Previous Occurrences

There has been only one documented dam failure in the City of Colorado Springs. That information was gathered from the flood hazard section of the 2005 Plan. It is unclear whether or not the 'victim' described in the plan was a fatality or injury. The 2013 State Mitigation Plan does not list any occurrences.

Date	Description	Source
1929	College Gulch flooded by 15 ft. wall of water caused by the breaking of dams on Ute Pass Fish Club – wiped out Crystola, Midland tracks, 1 victim.	2005 Plan

Probability of Future Occurrence

Unlikely: *Less than 1% chance of occurrence in the next 100 years or a recurrence interval of greater than every 100 years.*

There was only one known dam failure in the area. Based on previous occurrences, it appears unlikely for a dam failure to occur in Colorado Springs or vicinity. However, it should be noted that the conditions of all private dams are unknown, whereas poor conditions may contribute to the likelihood of failure. All dams in Colorado fall under the regulatory authority of the Colorado Division of Water Resources Dam Safety Branch.

There are no known levee failures within the City of Colorado Springs. The Templeton Gap Levee is currently rated "marginally acceptable" by the USACE following Continuing Eligibility Inspections. With this rating, the project is still "active" and eligible to receive federally funded assistance to repair or rehabilitate it if damaged by future flood events under PL 84-99. The Templeton Gap Levee was listed as a high priority for funding in the 2013 City of Colorado Springs Stormwater Needs Assessment, Final Report at a cost of $10,626,551.

Climate Change Impacts

Generally, future climate scenarios suggest that the climate in Colorado will be warmer and drier with occasional extreme precipitation. Increased flood volume, especially flash flooding, could lead to increased pressure on dams and levees with

higher water levels. In addition, the effects of high velocity flash flooding could erode and scour parts of dams and levees potentially leading to breaches and failure.

Magnitude/Severity

Catastrophic: *Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and service for more than 72 hours*

Should a dam with a hazard potential rating of high or significant fail upstream from the City of Colorado Springs, the results would be devastating. Dam failures typically occur with little warning. Depending on the size of the dam and the inundation area, the loss of life and amount of damage could be catastrophic.

Vulnerability Assessment

Overall Summary and Impacts: The State of Colorado requires EAPs for all High and Significant Hazard dams due to the increased potential for loss of life and/or property damage in the event of a dam failure. This Plan helps to manage and mitigate the risks posed by Colorado Springs Significant and High Hazard dams.

The EAP is a formal document that outlines possible emergency conditions at a dam, sets forth actions to minimize damage and danger, and includes a plan for the dam owner to moderate or alleviate the problems at the dam. The EAP contains inundation map exhibits to help emergency management authorities identify the critical areas for action in case of an emergency. Should an emergency arise, the dam owner should refer to preplanned EAP procedures for issuing an early warning and notifying downstream emergency management authorities of the situation.

Identifying Structures and Estimating Potential Losses: Inundation maps should be included for each dam with an EAP. An inundation map illustrates which properties may be affected by floodwaters and shows the extent of flooding expected spatially within a geographic area. These maps will not be included in this Plan for security reasons, but remain on file with the owners of the dam associated with the EAP. Many EAPs remain on file with the Colorado Springs OEM, which has reviewed them, and with the El Paso County OEM.

Secondary Impacts: As indicated in Table 2 of the Colorado SEOP, dam failure as the original event can trigger secondary or cascading impacts that exacerbate risk from other hazards. As described in the Colorado SEOP, there is a strong possibility that the occurrence of one event will trigger one or more secondary events. A dam failure will obviously cause flooding downstream but could also trigger a HAZMAT incident if there is a fixed or mobile source of hazardous materials in the dam failure inundation area. A dam failure could also cause mass casualties and impact transportation, trigger urban fires, and cause utility disruption.

Future Development: Existing floodplain regulations will decrease future losses to such an event. However, upstream locations without floodplain regulations in effect, or unenforced, may lead to structures being built in the floodplain, thus creating more potential debris flows during major flood events or dam failures and could damage or destroy downstream dams. Any additional development downstream of a dam could elevate the dam hazard ranking and the level of risk.

Data Limitations

Due to national security measures, access to dam data is fairly limited. Inundation areas associated with a failure are not included in this Plan. Also, the existing conditions of private dams are not readily available.

4.4 Geologic Hazards

Geologic hazards originate from adverse geologic conditions that are a risk to human health and can cause property damage. Geologic hazards can occur abruptly or as a result of slow formation. For Colorado Springs, geologic hazards include:

- Earthquake
- Landslide, Subsidence, and Rockfall

4.4.1 Earthquake

Hazard Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. The amount of energy released during an earthquake is usually expressed as a Richter magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking, typically the greatest cause of losses to structures during earthquakes, at any given location on the surface as felt by humans and defined in the Modified Mercalli Intensity Scale.

Table 4-23: Magnitude and Intensity Scales for Earthquakes

Magnitude and Intensity Comparison	
Richter Scale	**Maximum Modified Mercalli Intensity**
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and Higher	VIII or Higher
Defined Modified Mercalli Intensity Scale Rating	
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 as an earthquake. Standing motor 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 heavy truck striking building. Standing motor cars rocked noticeably.

Defined Modified Mercalli Intensity Scale Rating	
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 to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial 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.

Source: USGS, online at http://earthquake.usgs.gov/learn/faq/?categoryID=2, accessed on February 6, 2010. 2016 updated link: http://earthquake.usgs.gov/learn/topics/mercalli.php

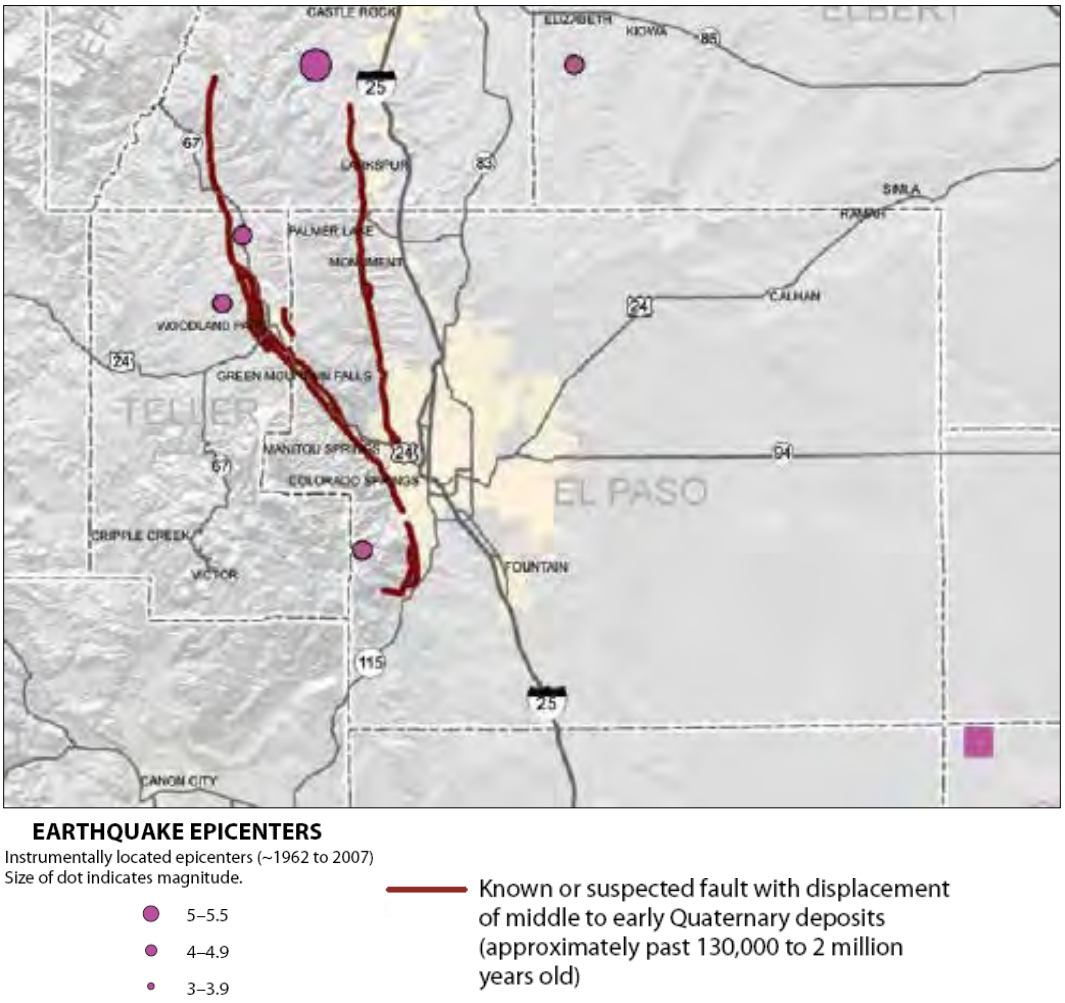
According to the CGS, Colorado is comprised of areas with low to moderate potential for damaging earthquakes. There are about 90 potentially active faults that have been identified in Colorado, with documented movement within the last 1.6 million years. However, there are several thousand other faults that have been mapped in Colorado that are believed to have little or no potential for producing future earthquakes.

Geographic Location

Earthquakes are a regional hazard that would affect all areas of Colorado Springs with similar magnitude and severity. Figure 4-15, taken from the Colorado Earthquake Hazards Brochure,[19] illustrates both the presence of quaternary faults in the Colorado Springs area and the epicenters of historical events. The Ute Pass Fault Zone runs approximately along State Highways 67 and 24 to the western edge of the city, and the smaller fault to the east of the Ute Pass Fault Zone is the Rampart Range Fault.

[19] Colorado Earthquake Hazards Brochure, Colorado Earthquake Hazards Mitigation Council, 2008.

Figure 4-15: Colorado Earthquake History and Fault Map, Colorado Springs Vicinity



Source: Colorado Geological Survey Earthquake History Map, http://coloradogeologicalsurvey.org/wp-content/uploads/2013/08/Earthquake_Map_20081.pdf, link updated February 8, 2016.

Previous Occurrences

There were six documented earthquakes in the State Earthquake Evaluation Report affecting El Paso County as listed in Table 4-24. Although the epicenters were relatively close to the City of Colorado Springs, these earthquakes did not impact the City in terms of damage. Most earthquakes that have occurred in this region have not been felt by humans. On the U.S. Geological Survey's (USGS) Colorado Earthquake history webpage (http://earthquake.usgs.gov/earthquakes/states/colorado/history.php), the closest event reported near Colorado Springs was a January 5, 1979 magnitude 2.9 tremor with an epicenter about 50 km northwest of Colorado Springs near Florissant and Lake George. Minor damage in the range of VI on the Modified Mercalli scale was reported at Cripple Creek and Royal Gorge. The 2013 State Mitigation Plan does not list any earthquakes for Colorado Springs or El Paso County.

Table 4-24: Known Historical Earthquakes, El Paso County, Colorado

Date	Location
12/23/1995	Manitou Springs
12/31/1995	Manitou Springs
1/19/1997	Woodland Park
4/18/1998	Woodland Park
7/22/2001	Woodland Park
2/19/2003	Woodland Park

Source: Colorado Earthquake Evaluation Report, http://www.dola.colorado.gov/dem/mitigation/earthquakerpt.pdf. [Link no longer operable]

Probability of Future Occurrence

Based on Previous Occurrences

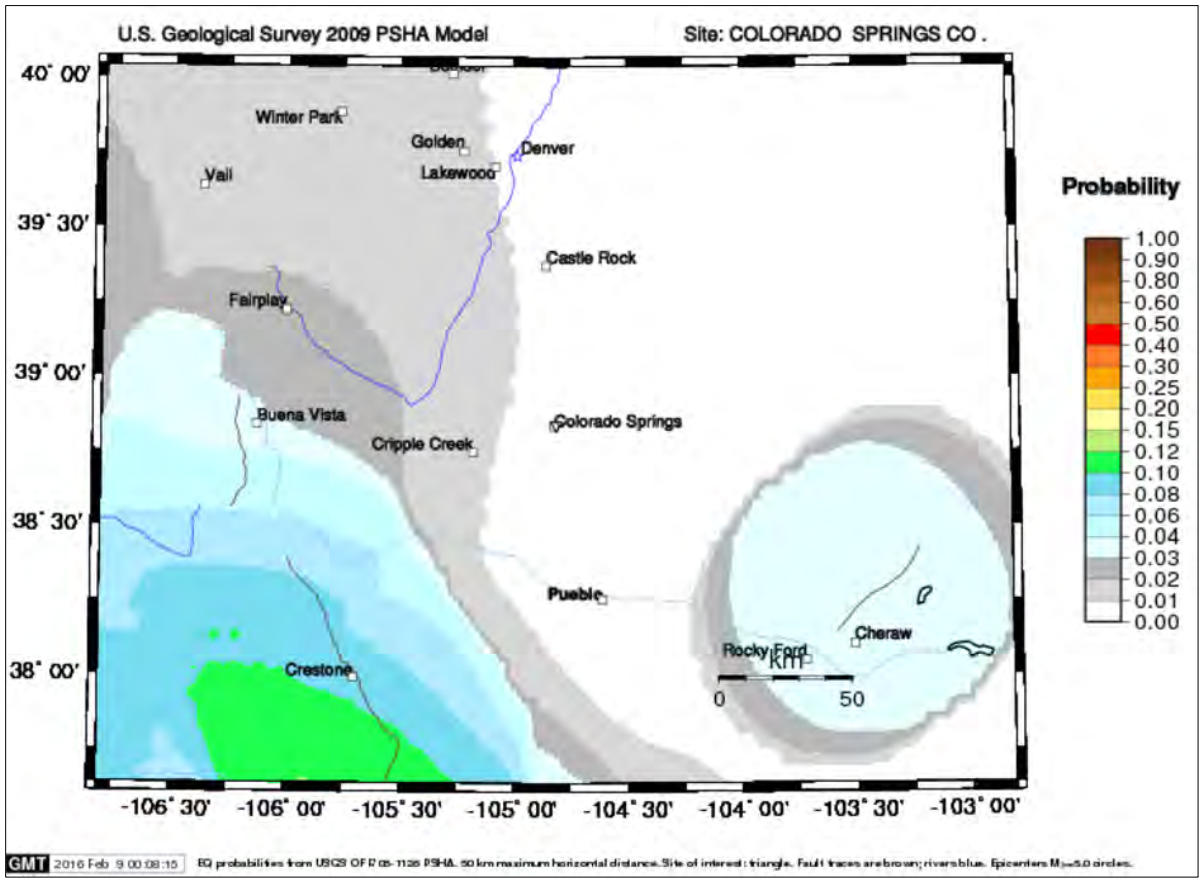
Occasional: *1-10% chance of occurrence in the next year or a recurrence interval of 11 to 100 years.*

Significant Earthquake (6.0 or 7.0)

Unlikely: *Less than 1% chance of occurrence in the next 100 years or a recurrence interval of greater than every 100 years.*

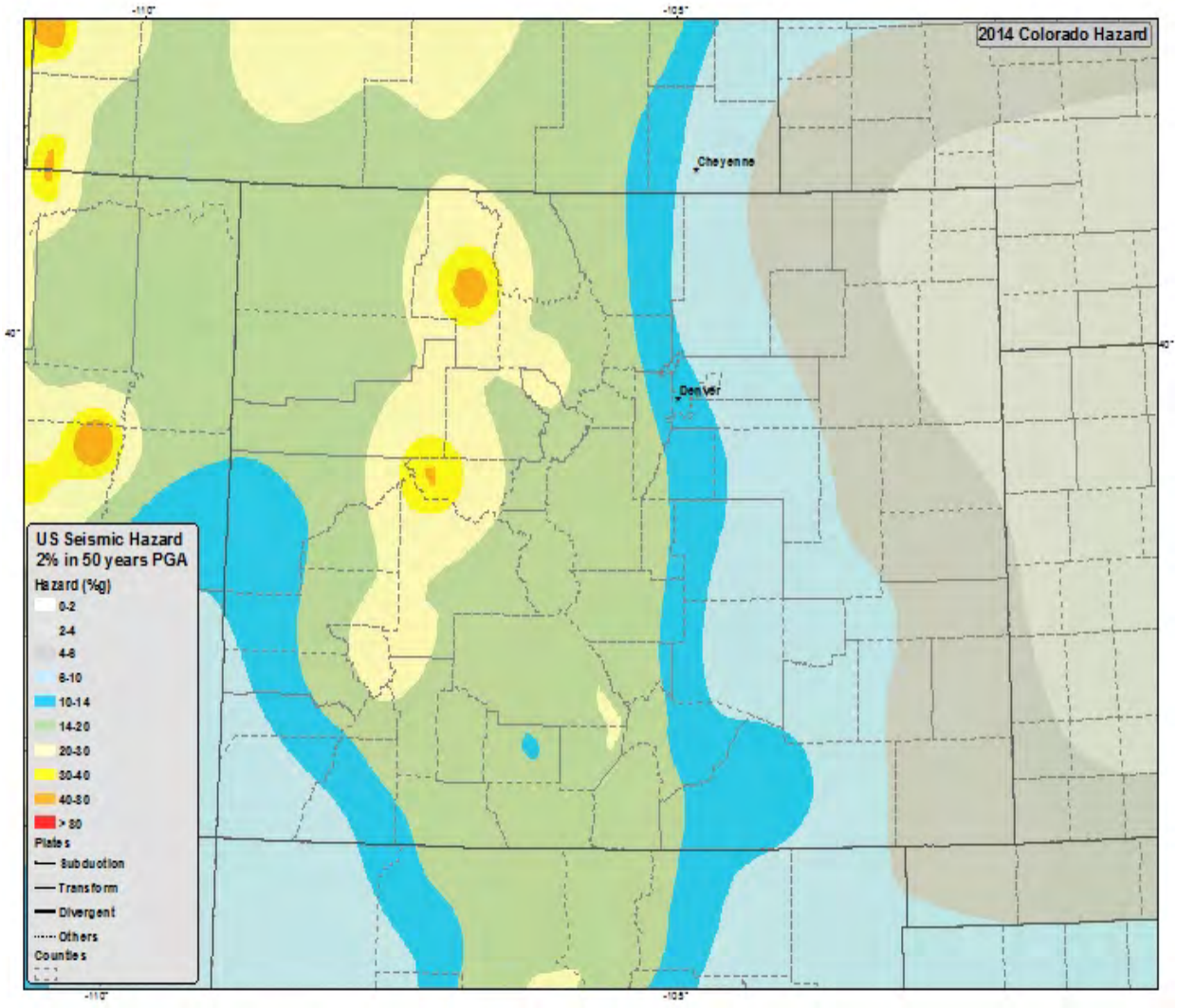
The occurrence of earthquakes is relatively infrequent in Colorado, and the historical earthquake record is short (only about 130 years). Basing probability on documented quakes from the Colorado Earthquake Evaluation Report may not provide the City of Colorado Springs with an accurate understanding of risk. There were six earthquakes in the vicinity from 1995 to 2003, equating to a 75% chance of an earthquake occurring in any given year, or once every 1.3 years. However, the earthquake hazard is thought to be not well understood and the potential for unknown active faults exists. Although the probability of an earthquake occurring in Colorado Springs is "occasional" based on previous occurrences, the purpose of this study is to determine potential losses from an earthquake large enough to produce damage and potential injury. The Colorado Earthquake Evaluation Report identifies El Paso County as being at the greatest risk regarding total economic losses and casualties, based on the Hazus analysis for that report. The USGS offers an online mapping system for earthquake probability as part of the USGS National Seismic Hazard Mapping Project. Figure 4-16 through Figure 4-19, illustrate the probability of a 6.0 and 7.0 or greater magnitude earthquake occurring near Colorado Springs within the next 150 years. The results show that there is up to 1% chance of a 6.0 event or a 7.0 event occurring within 150 years. In other words, the probability of a significant earthquake occurring in Colorado Springs is "unlikely."

Figure 4-16: Probability of Earthquake of 6.0 or Greater occurring within 150 years



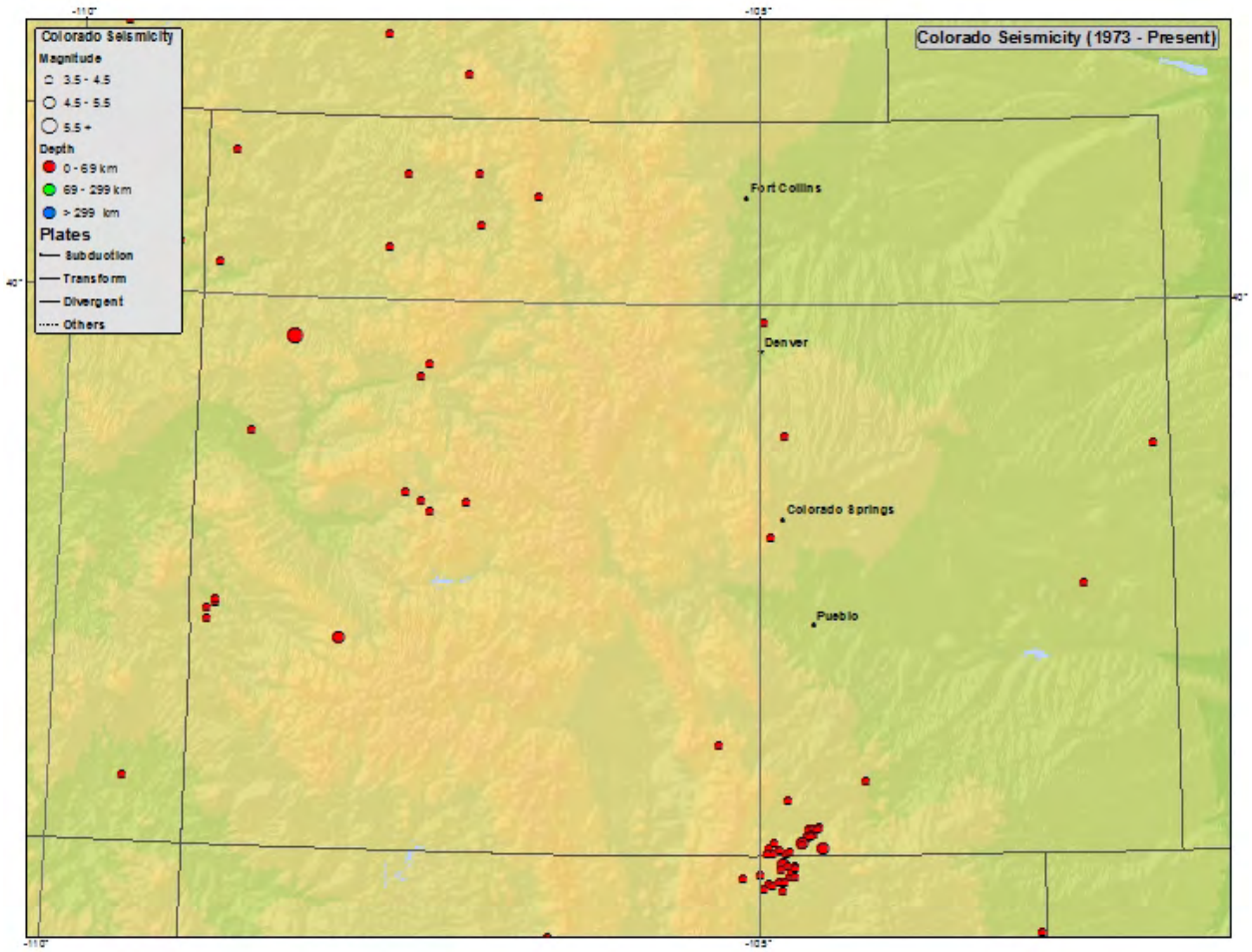
Source: USGS Earthquake Hazards Program, http://geohazards.usgs.gov/eqprob/2009/index.php, February 8, 2016.

Figure 4-17: 2014 Colorado Seismic Hazard Map



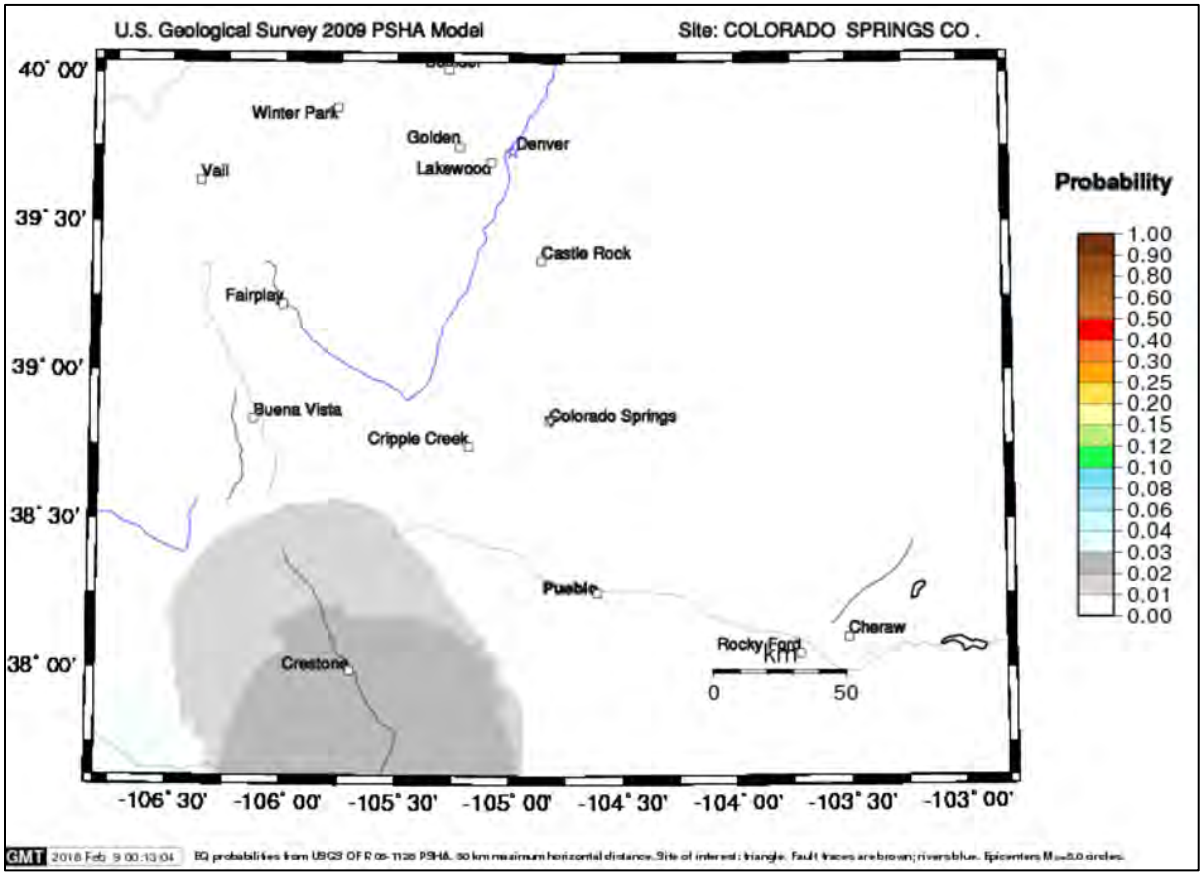
Source: USGS Earthquake Hazards Program, http://earthquake.usgs.gov/earthquakes/states/colorado/hazards.php, July 13, 2015.

Figure 4-18: Colorado Seismicity Map – 1973 to March 2012



Source: USGS Earthquake Hazards Program, http://earthquake.usgs.gov/earthquakes/states/colorado/seismicity.php, July 13, 2015.

Figure 4-19: Probability of Earthquake of 7.0 or Greater occurring within 150 years



Source: USGS Earthquake Hazards Program, http://geohazards.usgs.gov/eqprob/2009/index.php, February 8, 2016.

Climate Change Impacts

Earthquakes are geologic events that originate deep within the earth. Scientists with the USGS and the National Aeronautics and Space Administration (NASA) have studied the impacts of glacial melt due to climate change on the potential for earthquakes in southern Alaska.[20] The study found that when glaciers melt and retreat due to increased temperatures and changes in precipitation; the loading on the tectonic plates underlying the Earth's crust is lightened, freeing the plates to move against each other, resulting in friction that leads to earthquakes. Although few glaciers exist in Colorado, climate change and its impact on weather and interaction on the surface may have an impact on future probability and severity of earthquakes, and the extent of those impacts is unknown.

Future climate scenarios generally suggest that the climate in Colorado will be warmer and drier with occasional extreme precipitation, as noted previously. Increased temperature and extreme precipitation may also increase the potential for secondary impacts due to seismic activity, such as increased liquefaction due to saturated soils.

[20] "Retreating Glaciers Spur Alaskan Earthquakes," August 2, 2004. http://www.nasa.gov/vision/earth/environment/glacier_quakes.html. Accessed February 9, 2016.

Magnitude/Severity

Based on Previous Occurrences

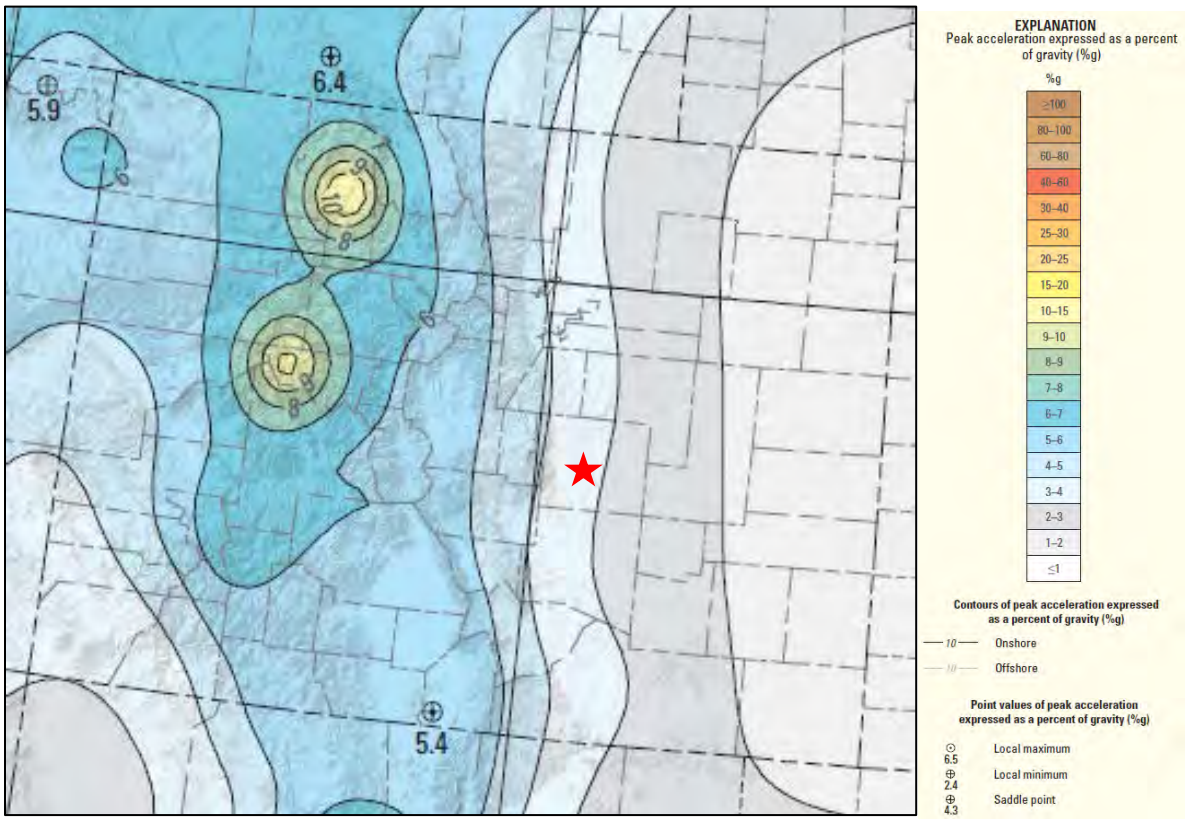
Negligible: *No or few injuries or illnesses; minor quality of life loss; little or no property damage; and/or brief interruption of essential facilities and services.*

Significant Earthquake (6.0 or 7.0)

Catastrophic: *Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and service for more than 72 hours.*

As shown in Figure 4-20, in Colorado Springs (western El Paso County), the shaking level with a 10% chance of being exceeded over a period of 50 years is in the range of 3 to 4% peak acceleration. Significant earthquake damage typically does not occur until peak accelerations are greater than 30%. Secondary impacts of earthquakes may include landslides, seiches, liquefaction, fires, and dam failure.

Figure 4-20: Seismic Hazard, 10% Probability to Exceed in 50 Years



Source: Excerpted from http://pubs.usgs.gov/sim/3325/pdf/SIM3325_sheet1.pdf. 2016 Update: In the 2010 Plan, this figure included historic earthquakes. The USGS no longer aggregates historic earthquakes with horizontal acceleration data.

Vulnerability Assessment

Overall Summary and Impacts: Due to the proximity of the City of Colorado Springs to several faults and folds, the possibility of a large earthquake is not entirely out of the question. Again, the documented earthquake history is relatively short in geologic time. Depending on the location of the epicenter, and the magnitude of the quake, ground shaking perception may differ from one area of the City to another. For the modeled scenarios in this Plan, the most intense ground shaking and damage would be in the western half of the City, including the downtown area where thousands of people would either be at work, or traveling to or from work. Significant ground shaking could damage structures, roads, critical infrastructure, and cause bodily harm or death.

Due to the rapid increase in the rate of earthquake incidents in the central U.S. since 2009, the USGS is currently studying earthquakes that can be attributed to human activity such as fluid injection that occurs with hydraulic fracturing or fracking. While Colorado Springs is not in an area that has been studied for induced seismicity, there are other parts of Colorado near the Rocky Mountain Arsenal and in southern Colorado near Trinidad that are being evaluated. More information on this subject is found on-line at http://earthquake.usgs.gov/research/induced/.

Identifying Structures and Estimating Potential Losses: All structures in Colorado Springs are potentially vulnerable to seismic ground shaking. The most vulnerable are historic buildings constructed of unreinforced masonry. Some historic buildings in Colorado Springs may be more susceptible to damage in a seismic event, due to the time period in which they were constructed.

The CGS ran a series of deterministic scenarios for selected Colorado faults, by county, using Hazus-MH to assess potential economic and social losses due to earthquake activity in Colorado. The earthquake magnitudes used for each fault were the "maximum credible earthquake" as determined by the U.S. Geological Survey. There are three faults within El Paso County: Colorado Springs Faults, Rampart Range, and Ute Pass. There were seven faults analyzed in the State Earthquake Evaluation Report to determine potential damage in El Paso County. They are the Chase Gulch, Cheraw, Goodpasture, Rampart, North Sangre de Cristo, South Sawatch, and Ute Pass.

Table 4-25: Fault Analysis from the State Earthquake Evaluation Report

Fault	Magnitude	Fatalities	Total Economic Loss ($Millions)
Chase Gulch	6.75	3	$494.6
Cheraw	7.00	2	$317.6
	5.50	0	$5.5
Goodpasture	6.00	0	$11.6
Rampart	7.00	114	$3,460.0
	6.50	75	$3,000.0
	6.00	22	$1,770.0
	5.50	3	$753.0
North Sangre de Cristo	7.50	0	$79.6
	6.50	0	$9.5
	5.50	0	$0.01

Fault	Magnitude	Fatalities	Total Economic Loss ($Millions)
South Sawatch	7.25	0	$29.7
Ute Pass	7.00	577	$7,920.0
	6.50	144	$3,300.0
	6.00	16	$988.0
	5.50	2	$282.6

Source: Earthquake Evaluation Report, www.dola.colorado.gov/dem/mitigation/earthquakerpt.pdf

According to the CGS analysis, the greatest losses to El Paso County would likely result from a 7.0 or greater magnitude earthquake on the Ute Pass fault. This event would result in estimated total economic losses of $7.92 billion and 577 fatalities.

2016 Plan Update

For this study, Hazus-MH 2.2 was run on the Rampart fault for the 6.0 and 7.0 magnitude events. During analysis, a software anomaly in the Hazus-MH 2.2 model was discovered while attempting to run the same events for the Ute Pass fault. Hazus programmers were not able to resolve the anomaly in time for completion of the Plan; therefore, the results for the Ute Pass Fault shown below were taken from the 2010 Plan, where the analysis was completed using HAZUS-MH MR4.

These faults were chosen based on their close proximity to the City limits. Because the model was set up based on census tract data, the defined region studied is larger than that of the City of Colorado Springs. Therefore, the damage estimates may be skewed. The 2016 region is comprised of 189,000 buildings, with an aggregate replacement value of $57,129,000,000. The population in this defined region (City plus a few areas outside), based on 2010 Census, is 525,533 people. Figure 4-21 shows the modeled earthquake Hazus region used for the 2016 Plan.

The Rampart fault models were run using the Western United States Extensional 2008 attenuation function for a normal fault. The epicenter was located near the southern end for each fault, nearest to downtown. Table 4-26 through Table 4-32 summarize the expected damage for each event scenario. The most damaging event based on the Hazus modeling would be the 7.0 magnitude on the Rampart fault, causing over $14 billion in building-related damage and 646 fatalities.

Table 4-26: Expected Building (count) Damage by Occupancy – Rampart Fault 6.0

Occupancy	Slight	Moderate	Extensive	Complete
Agriculture	85	86	44	11
Commercial	1,017	2,663	1,428	362
Education	74	89	48	11
Government	82	120	47	9
Industrial	495	692	396	103
Other Residential	3,335	3,154	1,278	275
Religion	206	244	127	30
Single-Family	36,207	21,407	6,784	990
TOTAL	**42,500**	**28,436**	**10,150**	**1,791**

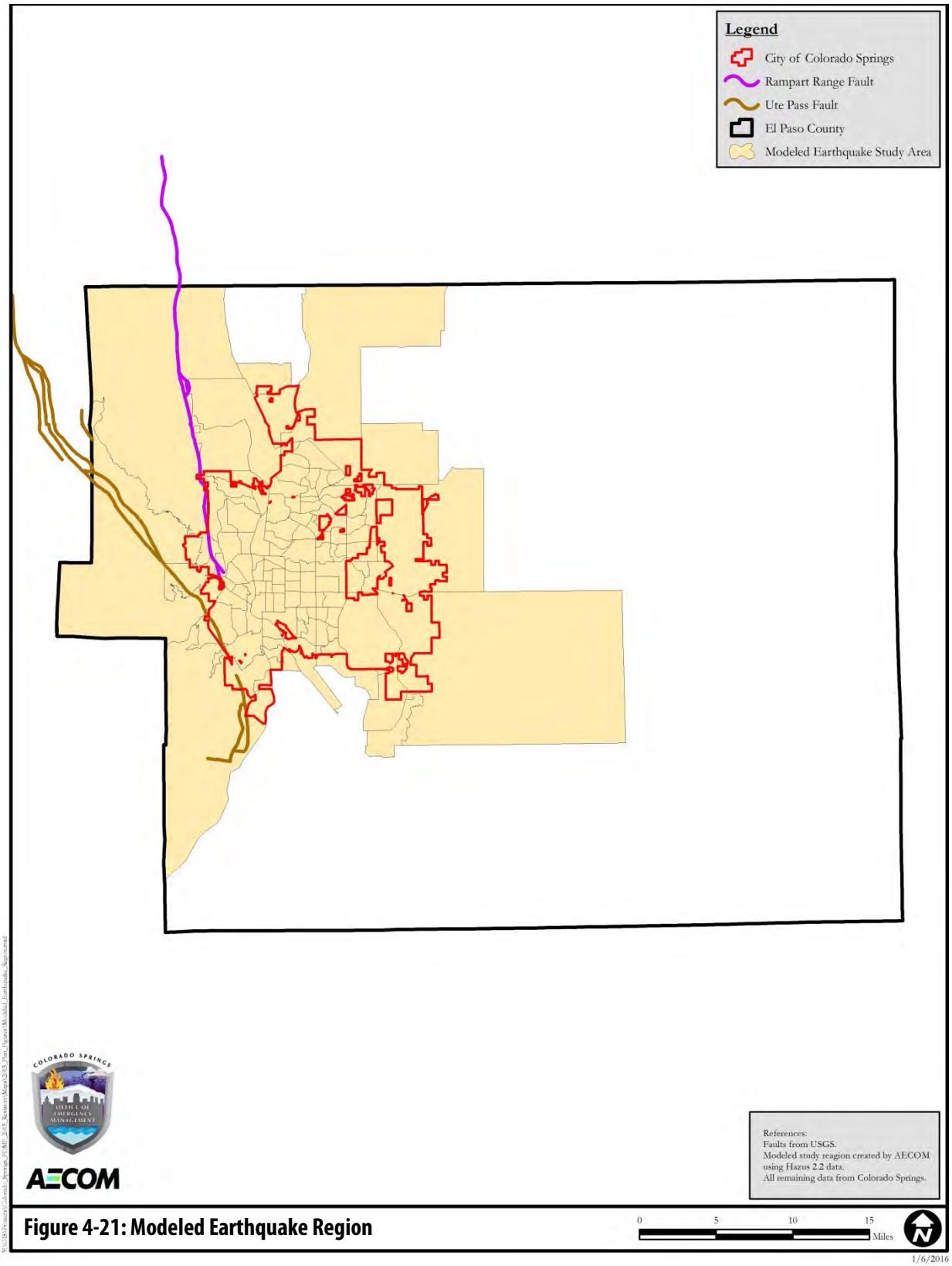


Figure 4-21: Modeled Earthquake Region

Table 4-27: Expected Building (count) Damage by Occupancy – Rampart Fault 7.0

Occupancy	Slight	Moderate	Extensive	Complete
Agriculture	81	109	91	65
Commercial	1,174	2,957	3,050	2,249
Education	56	101	104	74
Government	34	104	138	115
Industrial	300	752	813	634
Other Residential	2,772	4,013	3,313	2,042
Religion	154	273	278	195
Single-Family	44,635	40,433	18,756	7,028
TOTAL	**49,206**	**48,742**	**26,543**	**12,400**

Table 4-28: Expected Building (count) Damage by Occupancy – Ute Pass Fault 6.0 (from 2010 Plan)

Occupancy	Slight	Moderate	Extensive	Complete
Agriculture	85	83	41	11
Commercial	1,759	2,109	1,058	267
Education	55	62	30	7
Government	73	97	45	9
Industrial	496	627	326	80
Other Residential	5,916	4,922	1,890	373
Religion	137	153	76	17
Single-Family	24,771	13,927	4,619	728
TOTAL	**33,292**	**21,980**	**8,085**	**1,492**

Table 4-29: Expected Building (count) Damage by Occupancy – Ute Pass Fault 7.0 (from 2010 Plan)

Occupancy	Slight	Moderate	Extensive	Complete
Agriculture	86	114	99	79
Commercial	1,047	2,545	2,600	2,063
Education	42	76	80	60
Government	30	93	121	96
Industrial	291	720	770	642
Other Residential	5,709	6,909	5,078	3,414
Religion	107	185	191	144
Single-Family	32,675	29,268	14,700	6,552
TOTAL	**39,987**	**39,910**	**23,639**	**13,050**

Table 4-30: Expected Building-Related Economic Losses

Event	Losses*
Rampart 6.0	$4,976,000,000
Rampart 7.0	$14,859,120,000
Ute Pass 6.0 (2010 Plan)	$2,922,220,000
Ute Pass 7.0 (2010 Plan)	$10,537,570,000

* Includes income losses and structural and non-structural losses such as contents.

Table 4-31: Expected Casualties at 2:00 p.m.

Event	Injuries	Fatalities
Rampart 6.0	1,738	91
Rampart 7.0	8,967	646
Ute Pass 6.0 (2010 Plan)	1,293	68
Ute Pass 7.0 (2010 Plan)	7,618	563

Table 4-32: Expected Damage to Transportation and Utility Lifelines

Event	Losses
Rampart 6.0	$138,220,000
Rampart 7.0	$328,680,000
Ute Pass 6.0 (2010 Plan)	$153,170,000
Ute Pass 7.0 (2010 Plan)	$395,390,000

Figure 4-22 through Figure 4-25 show the results of the peak ground acceleration analysis modeled by Hazus for this Plan. The maps indicate the perceived shaking and potential damage for each earthquake scenario (6.0 and 7.0) on both the Rampart Fault and the Ute Pass Fault.

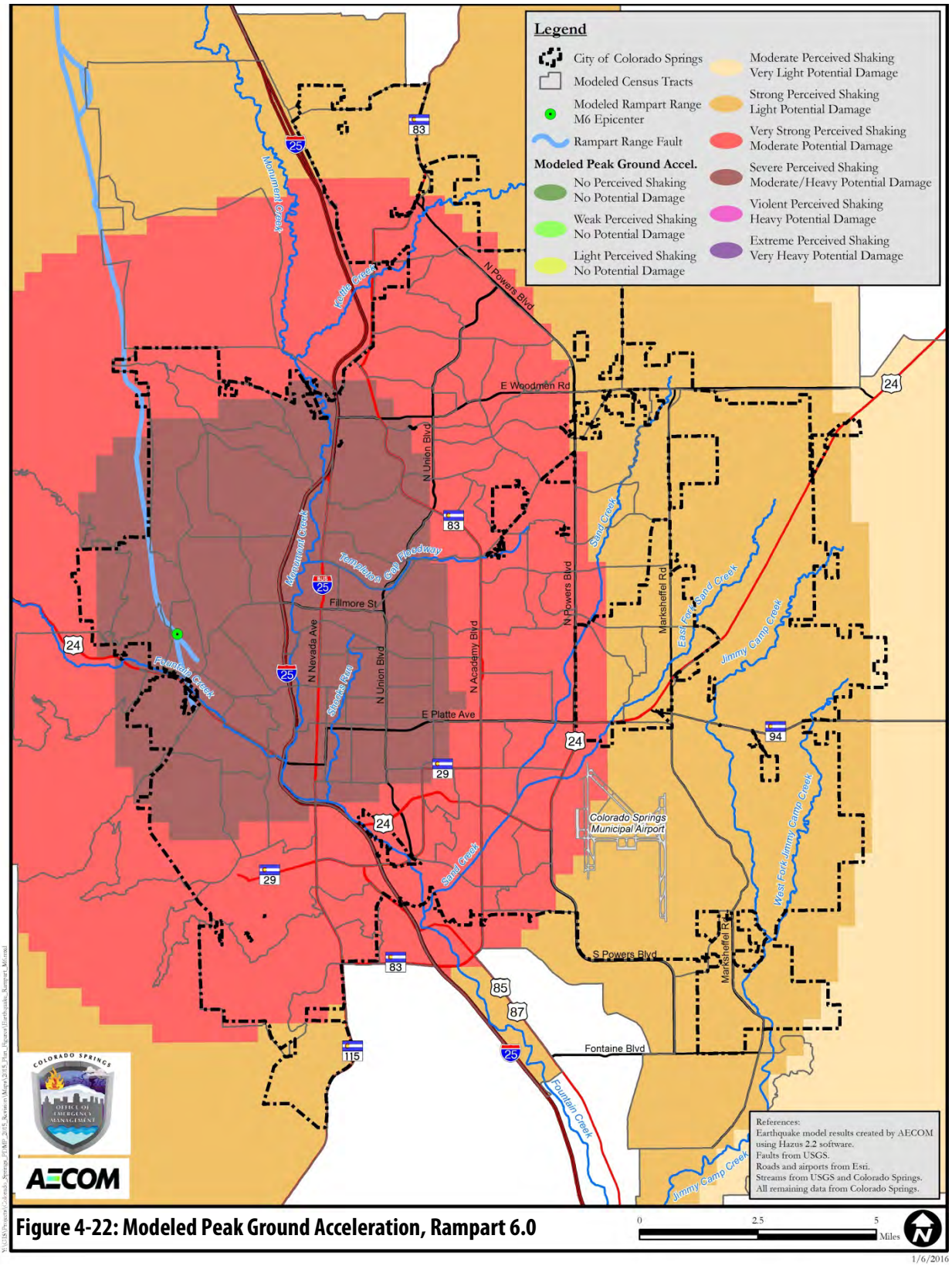


Figure 4-22: Modeled Peak Ground Acceleration, Rampart 6.0

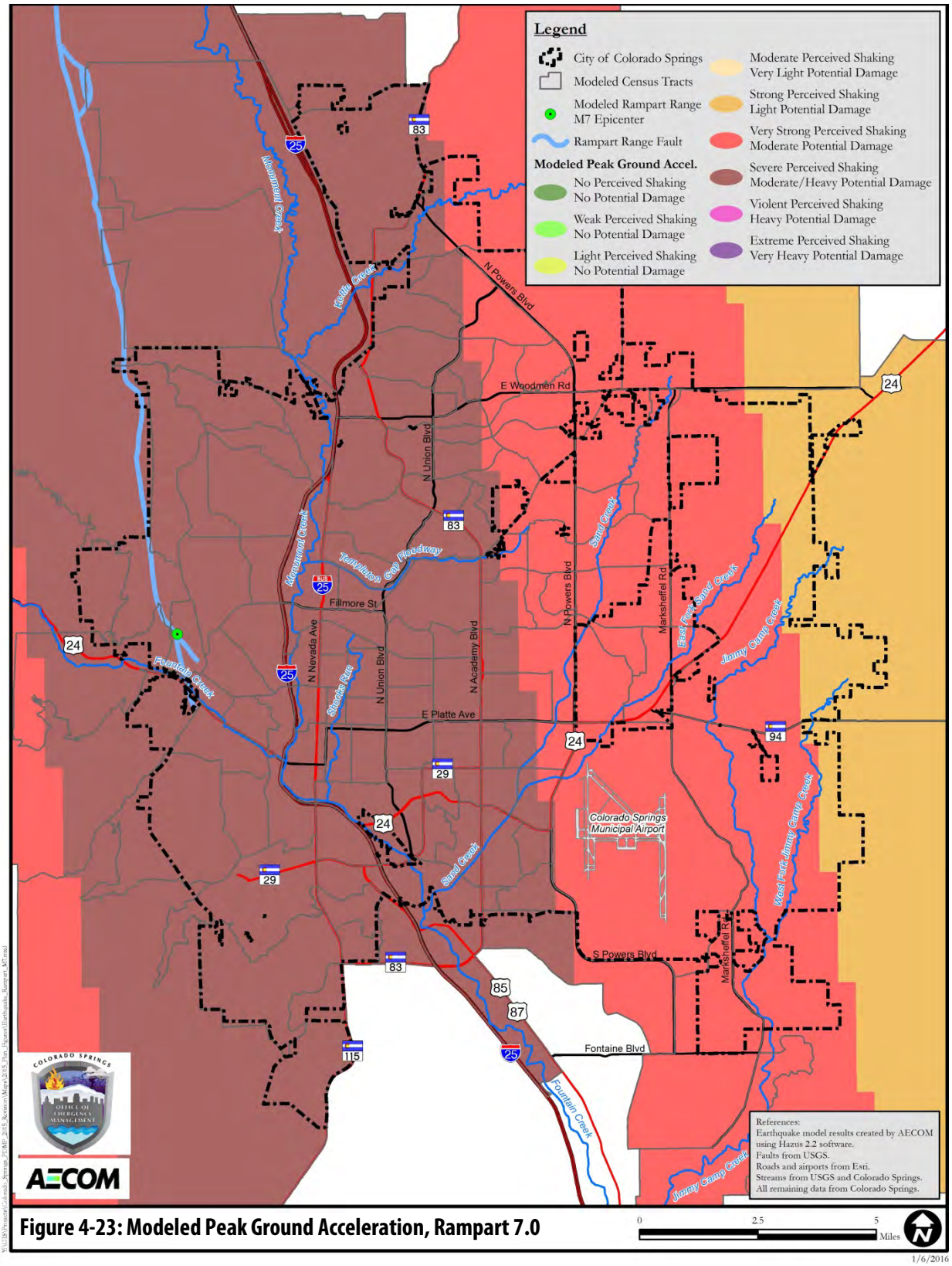


Figure 4-23: Modeled Peak Ground Acceleration, Rampart 7.0

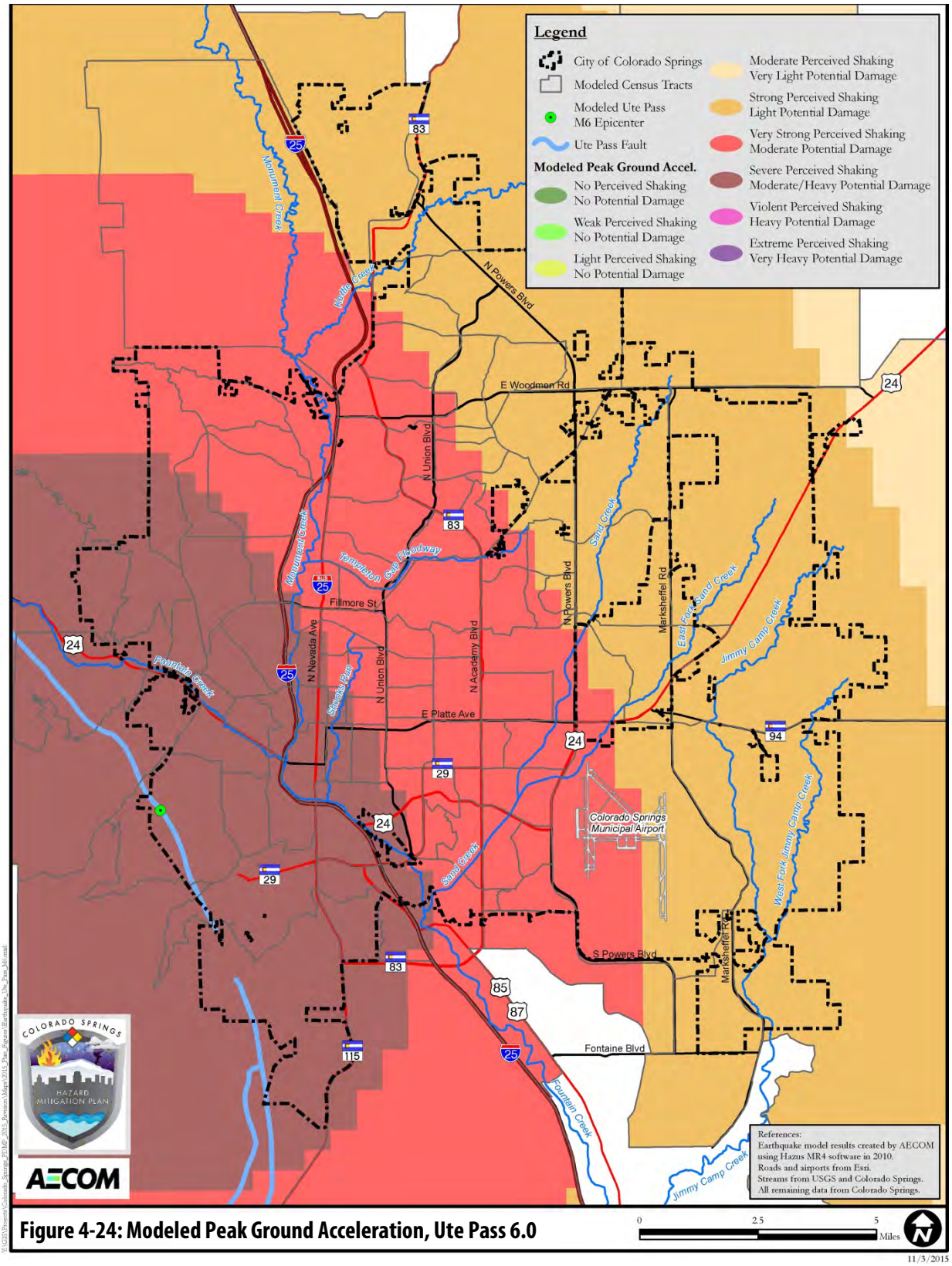


Figure 4-24: Modeled Peak Ground Acceleration, Ute Pass 6.0

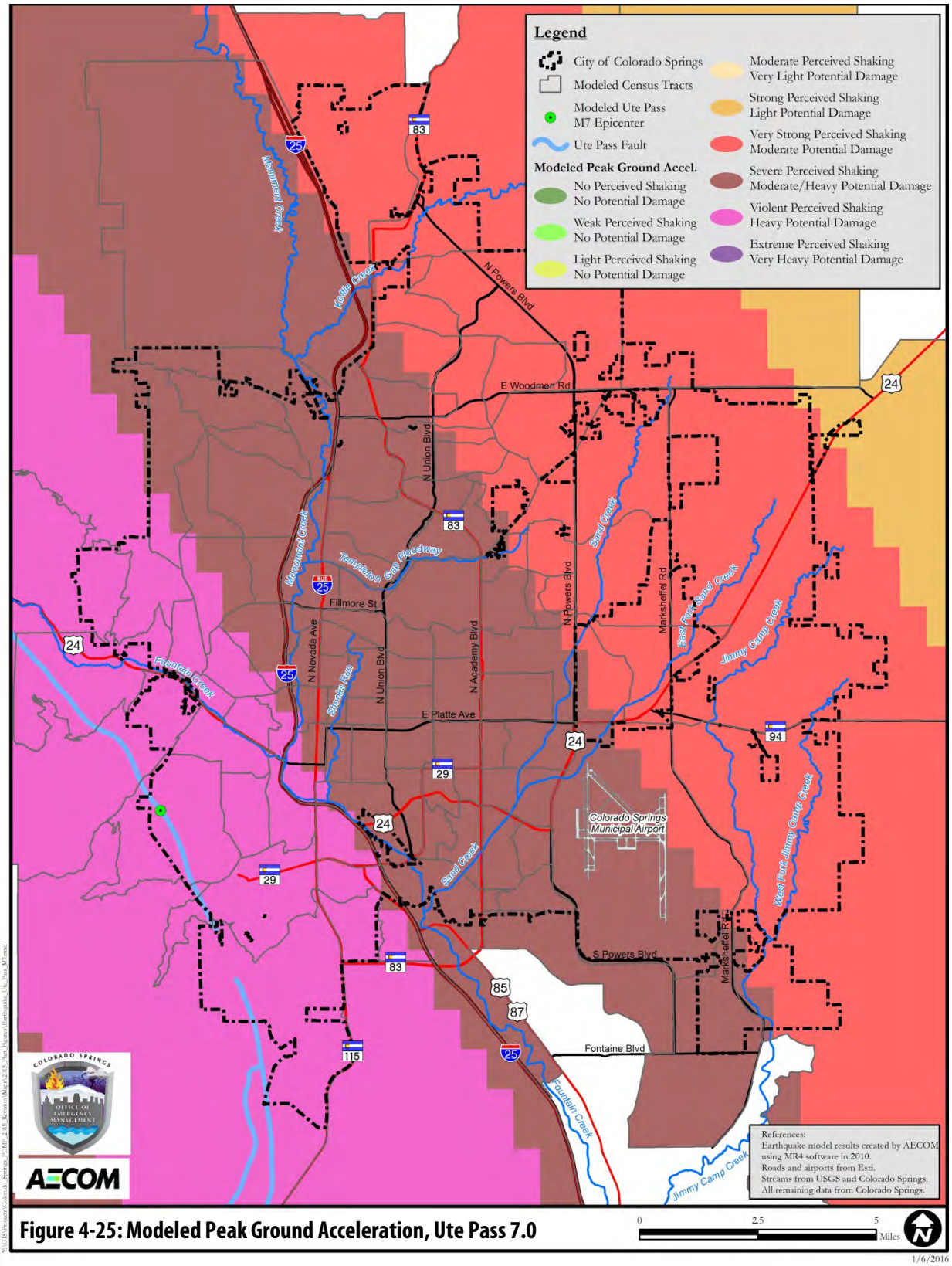


Figure 4-25: Modeled Peak Ground Acceleration, Ute Pass 7.0

Secondary Impacts: In addition to the initial damage and disruption caused by earthquakes, they can also trigger a series of aftershocks that can last for several days to several weeks. These aftershocks can cause additional damage and hinder recovery and rebuilding efforts. As described in the Colorado SEOP, earthquakes can trigger multiple secondary events including avalanche, dam failure, landslide, and subsidence. An earthquake can also trigger a HAZMAT incident by damage to the HAZMAT facility. It can also cause mass casualties and impact transportation, trigger urban fires, and cause utility disruption.

Future Development: Because the City of Colorado Springs has adopted building codes, the potential cost of damage to future structures from earthquakes is substantially reduced, compared to buildings that are not constructed to a code designed to withstand ground shaking.

Data Limitations

Estimating the timing or location of future dangerous earthquakes in Colorado with accuracy is not possible. The geologic historical records are quite short (about 150 years), and the lack of an adequate network of seismometers in Colorado makes earthquakes difficult to detect and locate.

4.4.2 Landslide, Subsidence and Rockfall

Hazard Description

Landslides include a wide range of ground movements from rock fall to slope failure, and are primarily attributed to gravity acting on steep slopes. Landslides are a very common geological hazard throughout the nation. The USGS lists the following contributing factors to landslide occurrences:

- Erosion by rivers, glaciers, or ocean waves creates over-steepened slopes.
- Rock and soil slopes are weakened through saturation by snowmelt or heavy rains.
- Earthquakes create stresses that make weak slopes fail.
- Earthquakes of magnitude 4.0 and greater have been known to trigger landslides.
- Volcanic eruptions produce loose ash deposits, heavy rain, and debris flows.
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures.

Subsidence is defined by the CGS as the sinking of the land over man-made or natural underground voids.[21] Subsidence can occur over a prolonged period of time, or abruptly in the form of sinkholes. Like landslides, subsidence can cause major damage to structures and infrastructure as the land moves and gives way.

Geographic Location

Landslides can occur anywhere there are unstable slopes, vulnerable underlying bedrock, or other conditions leading to slope instability. Landslides are more likely to occur on the western half of the city, near the foothills and/or other steep terrain.

[21]Colorado Geological Survey, http://coloradogeologicalsurvey.org/geologic-hazards/, verified on February 9, 2016.

Figure 4-27 shows the landslide susceptibility in the City of Colorado Springs. Rockfall susceptibility areas are generally confined to the more mountainous sections of Colorado Springs. Figure 4-32 is a map of rockfall susceptibility areas.

Former mining areas in Colorado Springs, as displayed in Figure 4-26, are of concern for subsidence. Colorado Springs' mining past may pose potential risk to current and future development. Subsidence is more likely to occur on the surface directly above abandoned coal mining operations. More specifically, these areas include the Rockrimmon Area, Cragmor/Country Club Area, Palmer Park, and Rustic Hills.[22] Figure 4-28 and Figure 4-29 show the undermined areas in Colorado Springs.

Figure 4-26: Mine Subsidence Pit on Vacant Lot, Cragmor Subdivision Area, 1996

Source: Photo by John W. Himmelreich, Jr., Provided by email February 26, 2010.

[22] As identified in the Dames and Moore Study, *Colorado Springs Subsidence Investigation*, 1985.

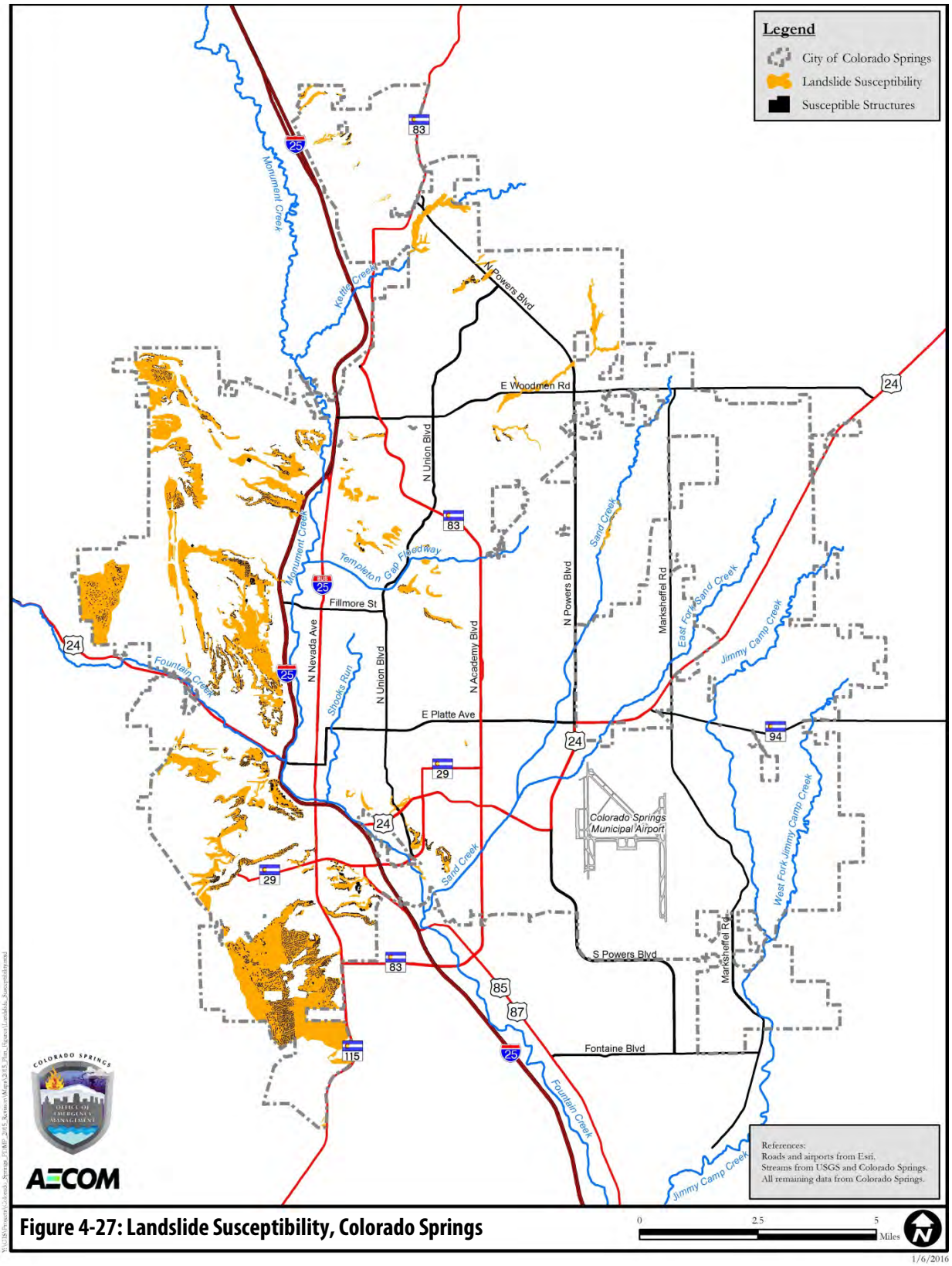
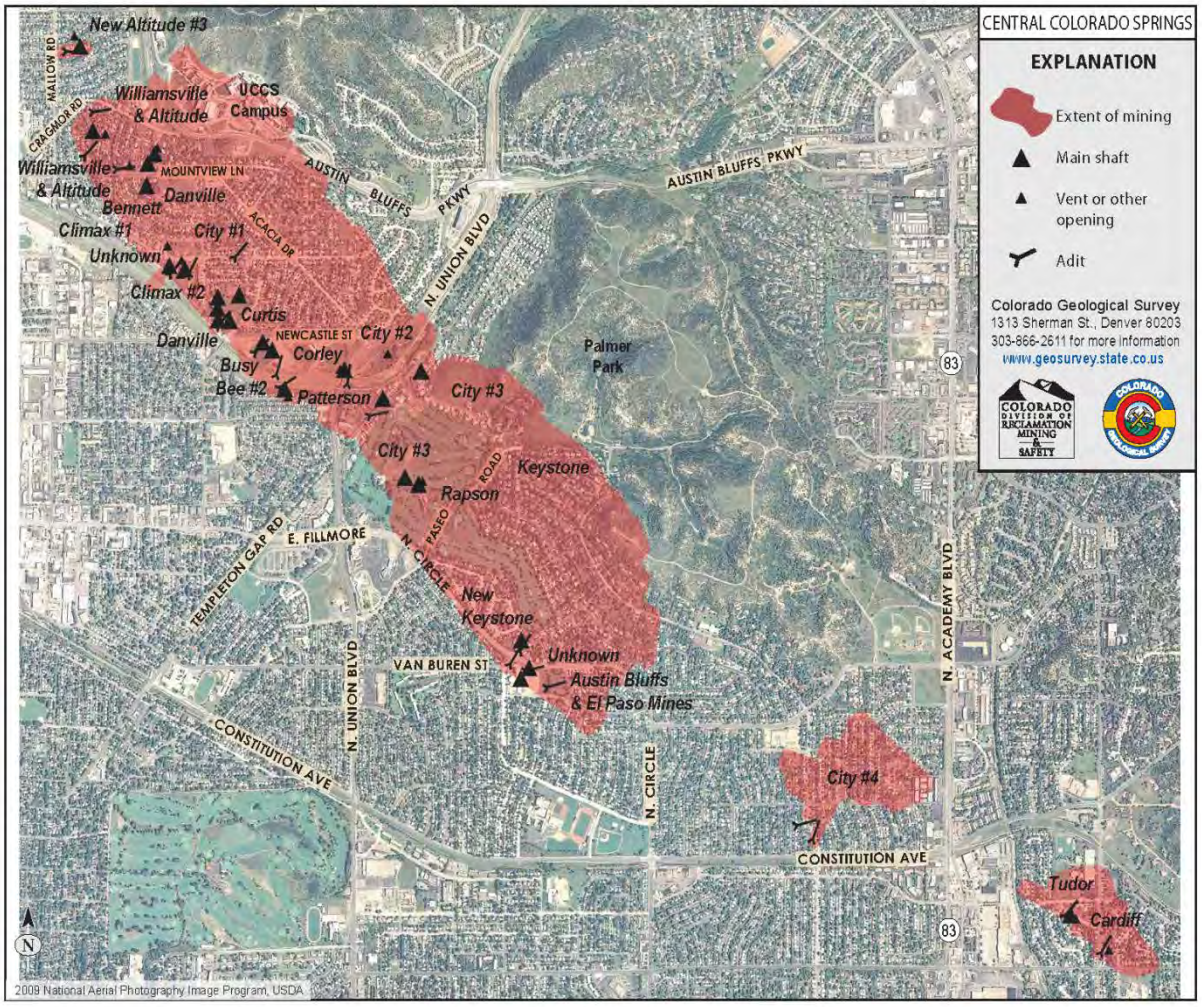


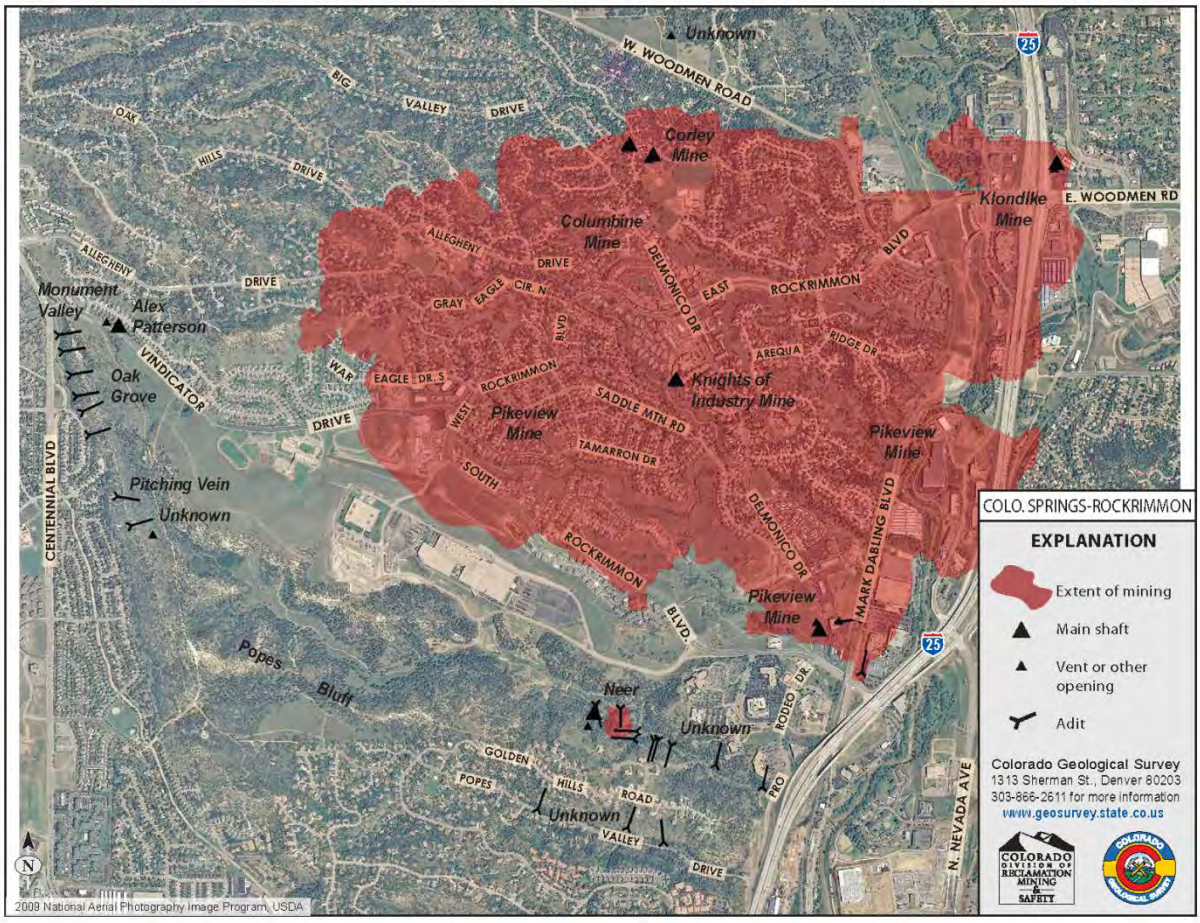
Figure 4-27: Landslide Susceptibility, Colorado Springs

Figure 4-28: Central Colorado Springs Undermined Areas



Source: Colorado Geologic Survey at http://coloradogeologicalsurvey.org/geologic-hazards/subsidence-mine/maps/ Accessed August 23, 2015

Figure 4-29: Colorado Springs – Rockrimmon Undermined Areas



Source: Colorado Geologic Survey at http://coloradogeologicalsurvey.org/geologic-hazards/subsidence-mine/maps/ Accessed August 23, 2015

Previous Occurrences

Table 4-33 summarizes the history of known landslide activity including rockfall in Colorado Springs. Table 4-34 summarizes the subsidence history of Colorado Springs and surrounding areas.

Table 4-33: Landslide History of Colorado Springs and Vicinity

Year	Description of Event	Data Source*
1959	Landslide in cut slope on Moreno Drive west of 8th Street	John W. Himmelreich, Jr.
1961+/-	Several landslides affected I-25 south of Academy Blvd.	John W. Himmelreich, Jr.
1962	Landslide on NORAD Road west of present day Paisley Drive	John W. Himmelreich, Jr.
1965	Road collapse due to heavy rains	John W. Himmelreich, Jr.
1965	I-25 south of Academy, road collapse due to heavy rains	John W. Himmelreich, Jr.
1965	August landslide impacts both northbound lanes of I-25, lanes closed	John W. Himmelreich, Jr.

Year	Description of Event	Data Source*
1965	Flash Floods cause major landslide at Cheyenne Mountain Zoo. There were damage to the ape and hippo houses, and the Seven Falls area. Boulders dislodged from Cheyenne Mountain crossed Hwy. 115 onto Fort Carson, also blocking entrances to NORAD. Flood resulted in four fatalities and caused major destruction in currently developed areas.	2005 PDM Plan
1966+/-	Landslide to west of Garner St. mobile home park (Gold Hill Mesa area)	John W. Himmelreich, Jr.
1970	9-11 inches of rain cause flooding and rock slides in Rock Creek Canyon	2005 PDM Plan
1970	21st Street drive-in area (west of 21st and north of Gold Camp Rd.)	John W. Himmelreich, Jr.
1971	South slope of Bear Creek between 8th street and I-25	John W. Himmelreich, Jr.
1973	Enlargement/reactivation of Bear Creek slide	John W. Himmelreich, Jr.
1976	500 block of 9th Street – landslide in cutslope	John W. Himmelreich, Jr.
1979	Reactivation of 9th Street slide	John W. Himmelreich, Jr.
1979	Landslide damage to 2 houses on Friendship Lane West	John W. Himmelreich, Jr.
1980	Landslide damage 3rd house on Friendship Lane West	John W. Himmelreich, Jr.
1980	Enlargement/reactivation of Bear Creek slide	John W. Himmelreich, Jr.
1983+/-	Landslide damages house on Mesedge Drive in Rockrimmon	John W. Himmelreich, Jr.
1986	Landslide damages Rockrimmon Terrace Apartments	John W. Himmelreich, Jr.
1993	Broadmoor South Golf Course. Forty-acre landslide disrupts golf course. Landslide enlarges to about 200 acres by 1999, damage to house and maintenance building.	John W. Himmelreich, Jr.
1994	Landslide damages Crestone Apartments above motor city area.	John W. Himmelreich, Jr.
1994	Water washed rocks from a hillside onto a highway. Road was closed, and several cars were washed into the ditch on September 3.	NCEI
1995	Landslides caused by abnormal springtime rains. Slopes failed in southwest Colorado Springs, destroying 2 homes, and badly damaging 2 others.	Colorado Springs PDM Plan 2005
1995	Mesa Rd. and 30th Street. Landslide closes bike path and encroaches on road. Slide reactivated in 1997.	John W. Himmelreich, Jr.
1995	Cedar Heights "Sleeping Indian" slide. Closed main road.	John W. Himmelreich, Jr.
1995	Landslide at Cheyenne Mountain Zoo, damage to access road.	John W. Himmelreich, Jr.
1995-1997	Four landslides along 30th Street. One closed 30th Street.	John W. Himmelreich, Jr.
1997	Landslide on slopes behind UCCS dorms. No damage to dorms.	John W. Himmelreich, Jr.
1997	Friendship Lane landslide causes severe damage to backyard, threatening home stability.	John W. Himmelreich, Jr.
1997	Landslide on slope behind ENPAC Building, threatening a city water line.	John W. Himmelreich, Jr.
1997	Landslide in Cedar Heights (Old Scotchman Way) partially blocked road and threatened home.	John W. Himmelreich, Jr.
1997	Landslide on slope on north side of Pinecliff area. Threatened houses above and below.	John W. Himmelreich, Jr.
1998	Rockrimmon Blvd. landslide at the Ridge Apartments destroys sidewalk and partially blocks road. Threatened apartment building.	John W. Himmelreich, Jr.
1999	Heavy rains caused tens of millions in damage from landslides. Following this event, the City with help from FEMA purchased 25 homes damaged by landslides and razed them.	PERI/CGS/2005 PDM Plan

Year	Description of Event	Data Source*
1999	Landslides damage Fountain Valley Pipeline south of Academy and west of I-25. $7 million to relocate pipeline and repair slope.	John W. Himmelreich, Jr.
1999	Numerous landslides on west side of Colorado Springs from Peregrine to Broadmoor Bluffs.	John W. Himmelreich, Jr.
2009	May 22nd, heavy rains brought flash flooding to South Cheyenne Canyon causing mud and rock slides and flooding of a road.	NCEI
2013	Mudslides damage property and kill 3 in aftermath of catastrophic September flooding	2013 State Mitigation Plan
2015	Landslides were caused by the May and June rainfall events; as a result, a Presidential Disaster Declaration was declared for El Paso County that included landslide and mudslide damage. The declaration was made on July 17, 2015 for Public Assistance. A new landslide in 2015 due to the very wet weather was in the Lower Skyway area.	FEMA website and LPC

*Event history provided by John W. Himmelreich, Jr. included his personal observations, photos, newspaper articles, air photos, consultant reports, and personal communications that he had collected over the years.

Pictures of landslides caused by higher than normal rains during May and June 2015. The picture on the right is in the Rockrimmon area. Source: City of Colorado Springs.

Table 4-34: Subsidence History of Colorado Springs and Vicinity

Year	Description of Event	Data Source
1979	Massive sinkhole 20-25 feet around an abandoned shaft of the Klondike Mine opened up near I-25 and Woodmen Road.	CGS
2005	Subsidence in Country Club neighborhood during concrete pumping activities to fill abandoned mine shafts.	http://www.gazette.com/articles/mine-17082-amundson-house.html

Year	Description of Event	Data Source
2009	Massive sinkhole opened up in the front yard of a Broadmoor home. The hole was approximately 25 feet deep and likely caused by leaking water.	http://www.kktv.com/community/headlines/79872332.html
2015	The record rainfall in May 2015 caused several sinkholes to open up, especially on roads.	OEM

Probability of Future Occurrence

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less.*

Historical data would suggest that a major landslide event would occur within the city once every 1.4 years. There were at least 39 events over a 55-year period, thus the probability is 71% that an event would occur any given year. However, it should be recognized that historical evidence may not be adequate for determining the likelihood of such an event. The City of Colorado Springs has completed several programs for mitigation of landslides; therefore the likelihood is decreased that an event would occur or result in the historical damage listed in Table 4-33. The follow excerpt is from the 2005 Plan:

> *There is no precise or accurate way to predict what other slopes may fail in the future or to what extent slope failures may continue to be a problem. The extent of future damage can be from light or minimal damage to total destruction of structures.*
>
> *A worst case scenario could develop for subsequent landslides in the future if several prolonged low intensity saturating rainstorms (e.g. where it drizzles for 4 or more days continuously per storm) occur over a few months. Under these conditions slope failures may begin to develop. Depending on the condition of the underlying material some of this moisture may be able to penetrate quickly to reach material that is susceptible to failure. At other locations it may take quite a bit of time for the moisture to reach a potential weak layer or zone.*
>
> *Landslides that have already occurred could be reactivated by excess moisture conditions.*

Figure 4-30: Landslide on Friendship Lane, 1997

Source: Photo by John W. Himmelreich, Jr., Provided by email February 26, 2010.

In a study conducted by Dames and Moore in 1985, *The Colorado Springs Subsidence Investigation,* it was determined that the highest hazards for subsidence occurred in the Cragmor/Country Club Area, Palmer Park, and Rustic Hills, over areas where room and pillar and extraction techniques were utilized by previous mining activity. The probabilities are noted in Table 4-35.

Table 4-35: High Hazard Zones for Subsidence in Colorado Springs, 1985

Area	Type of Mining	Total Overburden Thickness	Probability of Subsidence	Assigned Hazard
Cragmor/Country Club, Palmer Park, Rustic Hills	Room & Pillar	0-67.5'	.32	High
Cragmor/Country Club, Palmer Park, Rustic Hills	Extraction	0-67.5'	.27	High
Rockrimmon	Extraction	--	NA	High

Source: Colorado Springs Subsidence Investigation, Dames & Moore 1985.

Climate Change Impacts

Landslides, subsidence, and rockfall are essentially geologic events and would only be impacted by climate change to the extent other variables like flash flooding or drought may contribute to a landslide. The exact impact would require extensive, detailed study so for this plan, it is assumed that cycles of increased flooding, drought, and fire would likely accelerate forces contributing to landslides and therefore make future landslides more frequent and severe.

Magnitude/Severity

Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours.*

Landslides and slope failures in the past have caused major structural damage to homes and businesses. A significant landslide could not only demolish the above ground structures, but also wreak havoc on underlying utilities (gas, electric, water, etc.), and cause personal harm and/or death should these events occur quickly without warning. Damage from subsidence can range from hairline cracks in plaster or wall board, to damaged foundations, to major road failure with injury and/or death in the case of abrupt failure.

Vulnerability Assessment

Overall Summary and Impacts: The general assessment for where landslides may occur within the Colorado Springs vicinity is somewhat predictable based on slope, aspect, vegetation, moisture content, and angle of bedrock amongst other variables. At the individual parcel level however, the threat of landslides typically requires further study. Individual soil properties, the type of human activity on the lot, and understanding previous failures in the specific area all influence the probability of a future event occurring. Based on the overall susceptibility research conducted by the CGS, the bulk of the landslide/rockfall vulnerability is in the western half of the City, where the topography is mountainous and soils are less stable. Subsidence vulnerability is generally greatest in the location of former mining areas as shown in Figure 4-28 and Figure 4-29.

Identifying Structures and Estimating Potential Losses: There are 8,103 structures within the identified landslide susceptibility areas defined in the CGS' Map of Potential Areas of Landslide Susceptibility in Colorado Springs, El Paso County, Colorado 2003 (the most recent version available during the planning process). This equates to 4.4% of the total buildings in the City of Colorado Springs. There are 2,899 structures located within historic landslide areas defined by a consultant through previous study, identified by remote sensing and/or other means, or published documented landslides in geological studies. These structures are shown in Figure 4-31.

There are 359 structures that are within the rockfall susceptibility zone, according to GIS data provided by the CGS from the *Rockfall Hazard Susceptibility in Colorado Springs, El Paso County, Colorado 2006*. Figure 4-32 illustrates the location of those structures related to the City of Colorado Springs as a whole.

There are also hundreds of structures located in Central Colorado Springs and the Rockrimmon undermined areas leaving these structures vulnerable to subsidence.

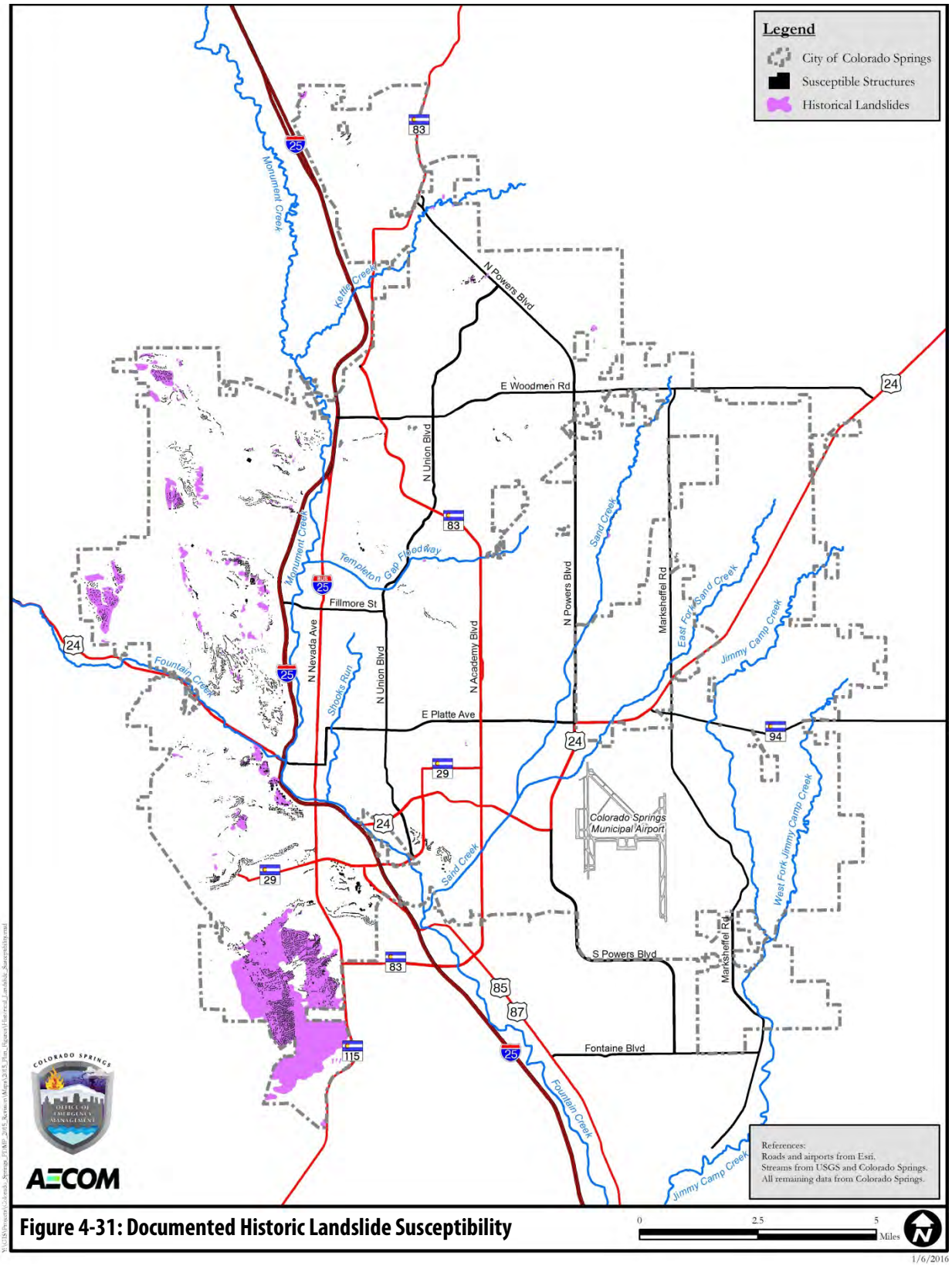


Figure 4-31: Documented Historic Landslide Susceptibility

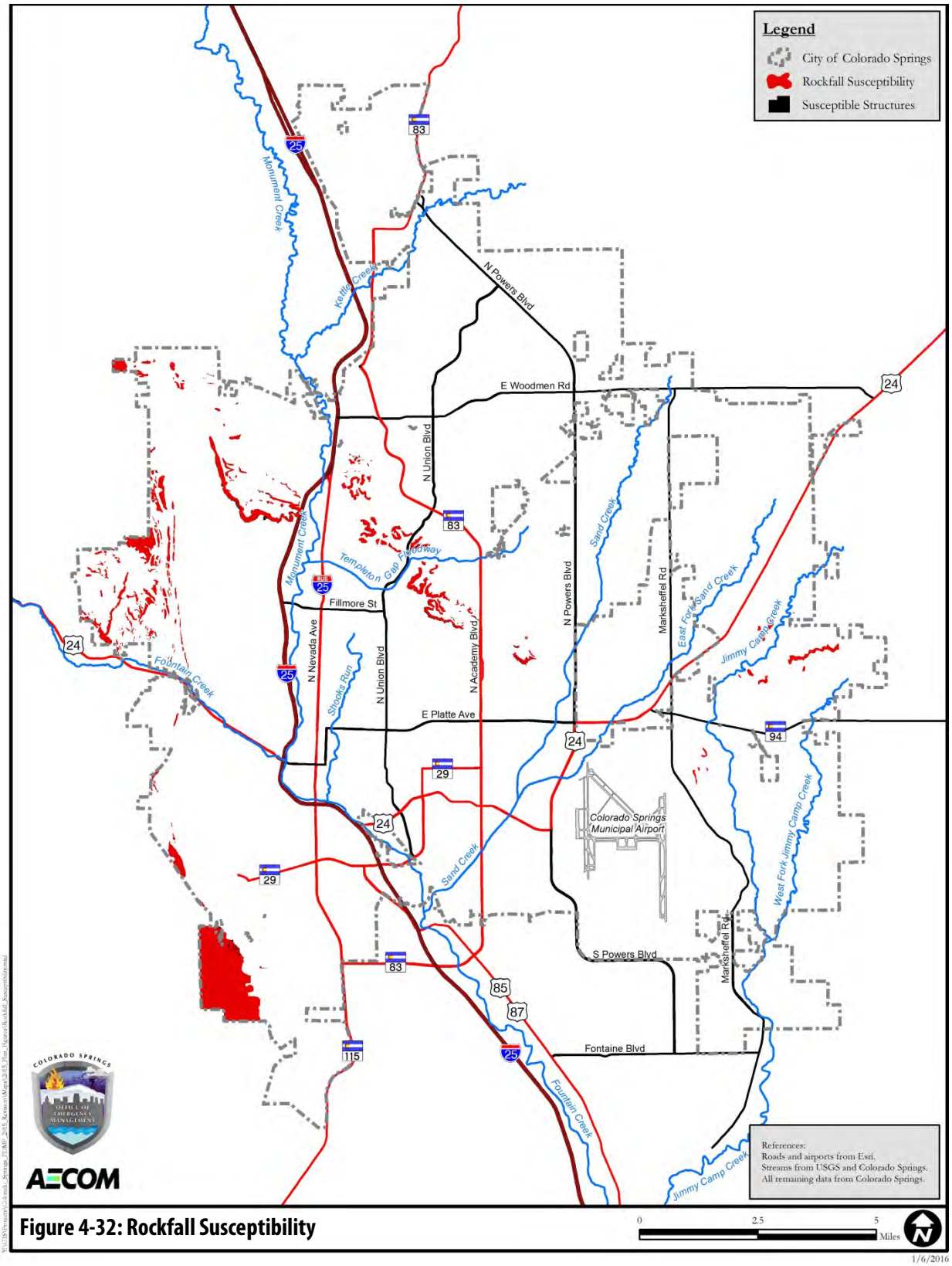
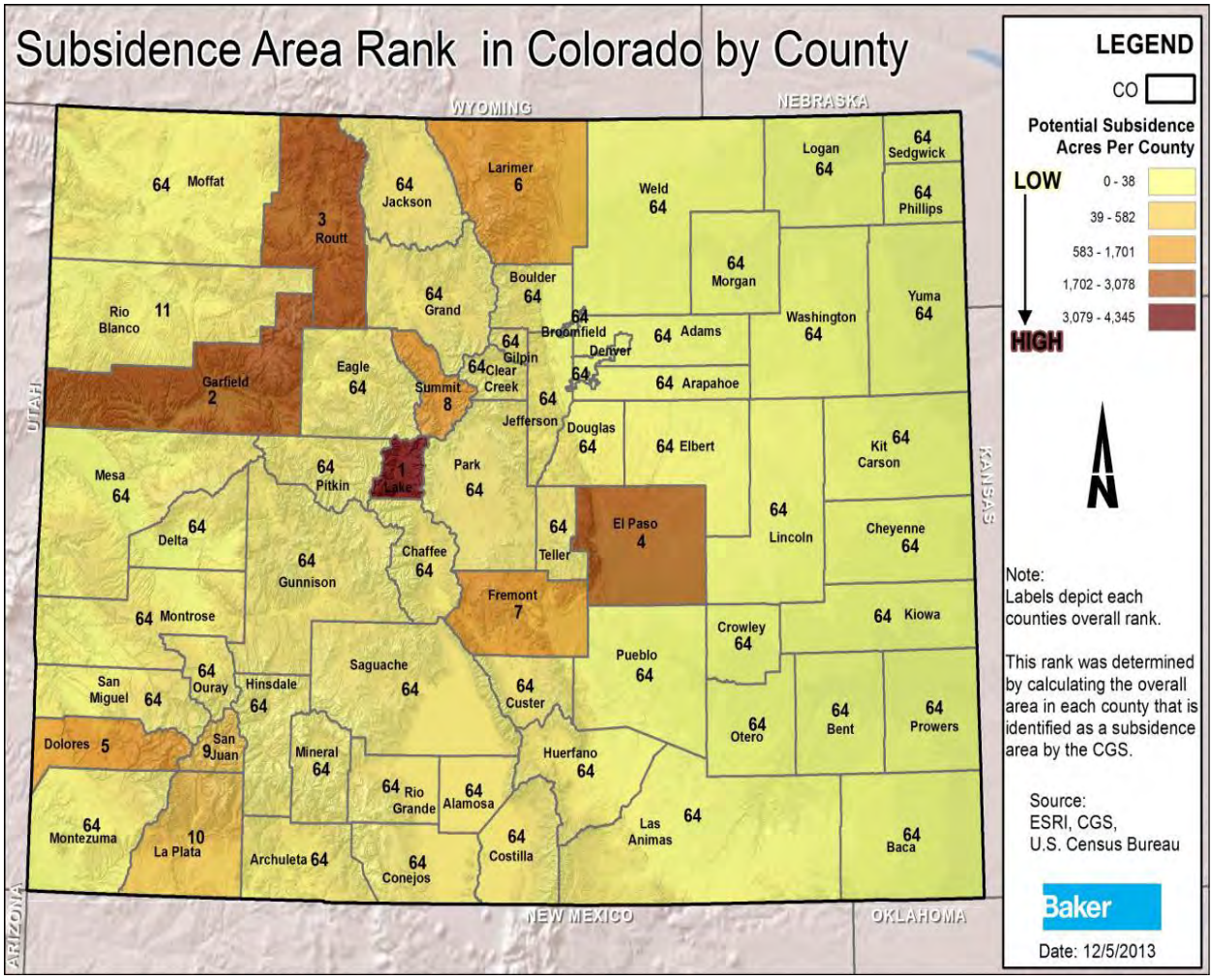


Figure 4-32: Rockfall Susceptibility

The 2013 State Mitigation Plan lists Lake County as having the most subsidence area compared to the total area of the county (see Figure 4-33). After Lake County, Garfield, Routt, and El Paso Counties have a relatively high amount of subsidence areas compared to total county area.

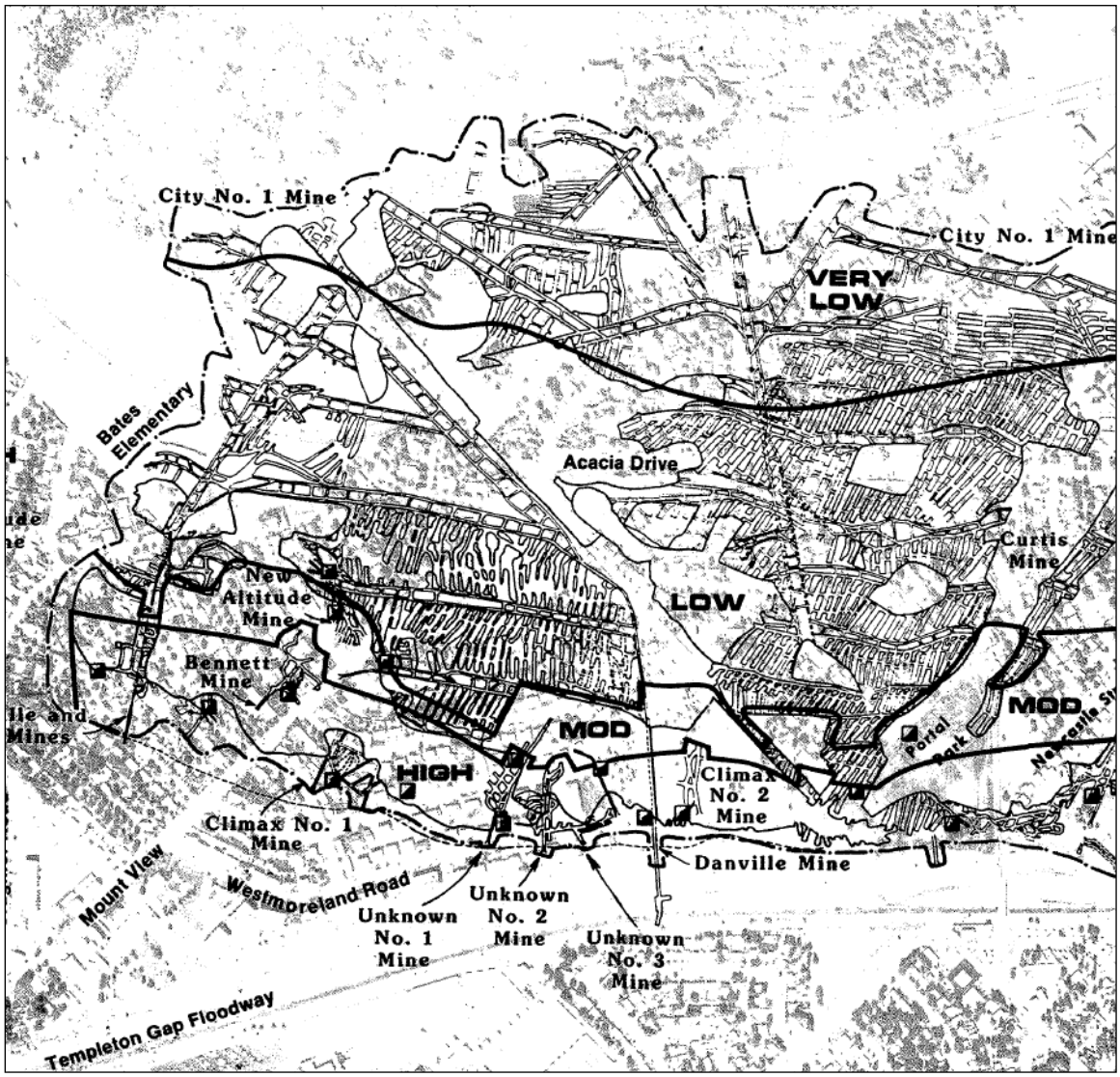
Figure 4-33: Subsidence Area Risk by County



Source: 2013 Colorado State Mitigation Plan.

Figure 4-34 presents a 1985 map showing the relative risk from subsidence in the central Colorado Springs area.

Figure 4-34: Example Map from Dames & Moore Study



Source: Colorado Springs Subsidence Investigation, Dames & Moore 1985, Map Plate 3.

Secondary Impacts: Landslide and subsidence as the original event can trigger secondary or cascading impacts that exacerbate risk from other hazards. As described in the Colorado SEOP, a landslide near a dam could trigger a dam failure. It can also trigger a flood by damming a water source or subsidence. A landslide could also trigger a transportation problem and a utility disruption. Subsidence could undermine transportation routes.

Future Development: In western Colorado Springs, development has occurred in many of the hillside sloped areas over the past 25 years. Intense cut and fill and an increase in lawn irrigation has led to a rise in subsurface water levels. This has resulted in marginally stable slopes becoming even less stable, and more sensitive to significant precipitation events.[23]

The City of Colorado Springs has established overlays to regulate hillside development in areas with unstable or potentially unstable slopes, areas with previous mining activity, or areas that exhibit other geologic hazards that could potentially compromise structures. These overlays exceed the typical development review process in order to proactively reduce the effects of landslides on development. In addition, the City of Colorado Springs passed a Geologic Hazard Ordinance that requires a geologic hazard study in conjunction with the City's review of development proposals in the hillside area overlay zone. These required studies identify the hazards affecting a site, analyze potentially negative impacts, and suggest mitigation techniques thus minimizing the risk posed to the development by any identified geologic hazards.

The Hillside Area Overlay was created by the City of Colorado Springs not only to protect the public health, welfare, and safety, but also to protect and complement the natural environment. Figure 4-35 is a map of the Hillside Area Overlay (and airport overlays). The areas in green are in the Hillside Area Overlay.

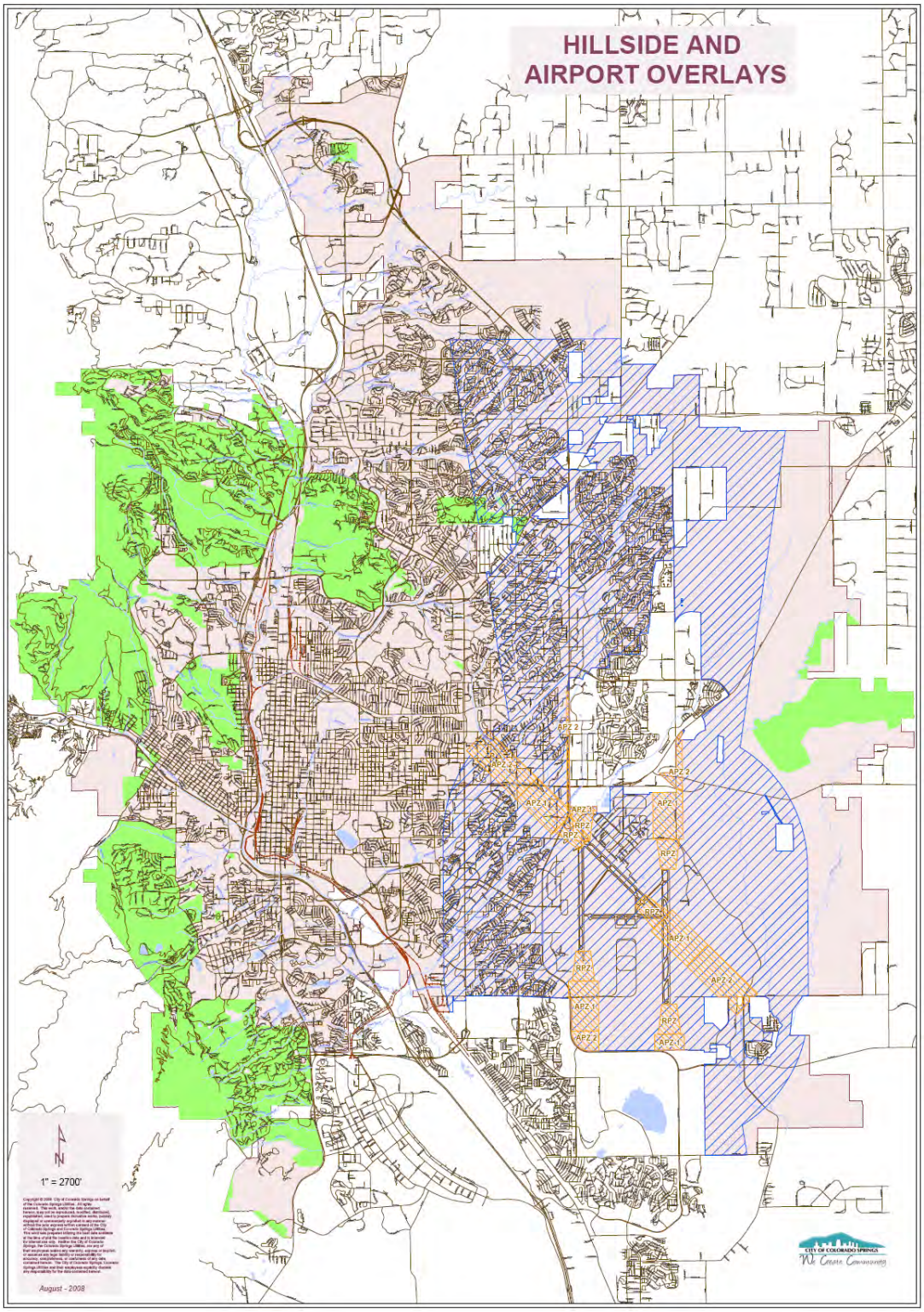
Central Colorado Springs and the Rockrimmon undermined areas are already heavily developed; subsidence would be a concern for continued development and redevelopment in these areas.

Data Limitations

The prediction of slope failures is difficult to achieve. Often slopes that were considered stable may fail under ideal conditions including but not limited to prolonged periods of rain and/or extensive cut and fill. Regional assessment of the risk to landslides is available; however, this information is not accurate to the individual parcel. Geotechnical studies must be prepared in order to determine a particular lot's vulnerability to slope failure.

[23] Colorado Landslide Mitigation Plan – Landslide Update, www.dola.state.co.us/dem/mitigation/landslideupdate.pdf, accessed November 10, 2009. Link no longer operable. Data remains applicable for 2015 plan.

Figure 4-35: Hillside Area Overlay for the City of Colorado Springs



Source: City of Colorado Springs, http://www.springsgov.com/Page.aspx?NavID=1040, accessed on December 3, 2009. Link verified for 2016 Plan.

4.5 Severe Weather Hazards

Severe weather hazards refer to dangerous and/or damaging meteorological events resulting from weather systems or prolonged climate patterns which include the following for Colorado Springs:

- Hail
- Tornado
- Lightning
- Windstorm
- Winter Storm
- Drought

4.5.1 Hail

Hazard Description

Hail is associated with thunderstorms that can also bring high winds and tornadoes. It forms when updrafts carry raindrops into extremely cold areas of the atmosphere where they freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is pulled by gravity toward the earth. Hailstorms cause damage to structures and other types of property, as well as crops, livestock, and in rare cases, to humans.

Geographic Location

Hailstorms can occur anywhere in Colorado Springs with equal probability and magnitude.

Figure 4-36: Mammatocumulus over the Air Force Academy, August 10, 2004

Source: NOAA Photo Library, http://www.photolib.noaa.gov/700s/wea02264.jpg, accessed on December 4, 2009. Link verified for 2016 Plan.

Previous Occurrences

There were over 1,060 records of significant hail storms in El Paso County from 1955 to 2015. One particular storm caused over $8.7 million in damage in Colorado Springs when large hail damaged 3,000 homes and 1,800 automobiles. Table 4-36 highlights a partial list of significant hailstorms in El Paso County, Colorado. It is not uncommon for storms in El Paso County to produce hailstones over two inches in diameter.

Table 4-36: Partial list of Significant El Paso County, Colorado Hail Events

Date	Diameter	Injuries*	Fatalities*	Property Damage ($)*	Crop Damage ($)*	Source
5/12/1961				1,923.08	0	SHELDUS
6/2/1961				1,851.85	18,518.52	SHELDUS
6/3/1961	1.00			25,000	0	SHELDUS/NCEI
7/1/1961				1,562.5	15,625	SHELDUS
5/17/1962	0.75			333.33	333.33	SHELDUS/NCEI
7/28/1962				0	5,000	SHELDUS
7/27/1963	1.00			500	0	SHELDUS/NCEI
5/29/1964				192	1,923	SHELDUS
8/4/1964	1.75			500,000	0	SHELDUS/NCEI
6/14/1965	1.00	1		5,000	0	SHELDUS/NCEI
6/17/1965	1.00			500,000	0	SHELDUS/NCEI
8/21/1965				16,667	0	SHELDUS
7/21/1966				172	0	SHELDUS
7/11/1967				50,000	0	SHELDUS
5/31/1968	1.25			1,667	0	SHELDUS/NCEI
7/24/1970	0.75		1	50,000	0	SHELDUS/NCEI
7/8/1971	0.75			5,000	0	SHELDUS/NCEI
7/18/1972	0.75			50,000	0	SHELDUS/NCEI
7/20/1973	0.75			166,667	16,667	SHELDUS/NCEI
7/22/1974	1.00	1		2,500	0	SHELDUS/NCEI
8/14/1977	1.50			50,000	0	SHELDUS/NCEI
7/9/1978	2.00			5,000,000	0	SHELDUS/NCEI
6/19/1980	2.00			17	16,667	SHELDUS/NCEI
6/12/1982	2.50	2		5,000,000	5,000	SHELDUS/NCEI
6/9/1985	1.75			50,000	0	SHELDUS/NCEI
7/9/1988	1.00			50,000	0	SHELDUS/NCEI
8/9/1988	1.75			500,000	0	SHELDUS/NCEI
6/20/1992	2.00			100,000	0	SHELDUS/NCEI
6/26/1992	2.00			11,000,000	0	SHELDUS/NCEI
7/23/1996	2.75	2		300,000	0	SHELDUS/NCEI
7/24/1996	0.75			8,700,000	0	SHELDUS/NCEI

Date	Diameter	Injuries*	Fatalities*	Property Damage ($)*	Crop Damage ($)*	Source
6/20/2001	4.00			2,000,000	0	SHELDUS
6/14/2002	1.00			24,000,000	0	SHELDUS/NCEI/ 2005 PDM Plan
7/9/2004	2.00					NCEI
8/10/2004	1.75					NCEI
8/23/2007	1.25			Significant		NCEI
6/6/2012	1.00			Significant		NCEI
6/7/2012	2.00			Significant		NCEI
6/28/2013	1.25			Significant		NCEI
7/10/2013	1.00			Significant		NCEI
5/21/2014	1.00			Significant		NCEI
6/12/2014	1.00			Significant		NCEI
6/14/2014	1.00			Significant		NCEI

*Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. Damage, Injuries, and Fatalities are divided between the affected counties by any one documented disaster within the SHELDUS database.

Probability of Future Occurrence

Highly Likely: *Near 100% chance of occurrence next year or every year.*

According to the historical data available, it is likely that a major hail event will occur every year. There were 1,060 major events on record in El Paso County since 1955, which carried forward equates to over 17 major events per year. Although not all recorded hailstorms affected Colorado Springs directly, one can infer that at least one major hailstorm will impact Colorado Springs annually.

Climate Change Impacts

The 2014 NCA is studying how climate change may impact severe weather events like tornadoes, hail and damaging winds but does not have the quality of data to determine how these storms might change in the future. The 2014 NCA does project, based on the increased frequency and intensity of winter storms and that their tracks have shifted northward of the U.S., that this trend will continue.

Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hour.*

Large hailstones are capable of damaging structures, automobiles, and harming individuals and livestock. Table 4-37 documents the typical damage associated with various intensity categories of hailstones.

Table 4-37: TORRO Hailstorm Intensity Scale

Intensity Category	Diameter (in.)	Size Description	Typical Damage Impacts
Hard Hail	0.2-0.4	Pea	No damage
Potentially Damaging	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	1.6-2.0	Golf ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
Super Hailstorms	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organisation (TORRO), Department of Geography, Oxford Brookes University.

Vulnerability Assessment

Vulnerability Summary: The City of Colorado Springs is vulnerable to significant hailstorms in the future. Although weather forecasting provides warning for upcoming events, knowing exactly where and how large of an impact to people and property is nearly impossible to predict. Hail-producing thunderstorms are a regular occurrence in Colorado Springs, and it is reasonable to expect future damage to automobiles, structures, and potentially individuals.

Identifying Structures and Estimating Potential Losses: Hail affects the entire planning area, including all above-ground structures and utilities. Structure damage due to hail is typically covered under private insurance. Personal injury can also occur as a result of hail if individuals are outdoors. Large hailstorms can result in localized flooding when the hailstones form dams in stormwater drainage ways. These secondary effects of hail are difficult to predict or prevent but can cause significant damage to structures.

Secondary Impacts: The Colorado SEOP does not list any secondary impacts from hail but it is possible it could cause a utility disruption through damage to control panels.

Future Development: Building standards can offer only limited protection from hail damage. High population growth and development increases vulnerability to major hailstorms. The City of Colorado Springs ordinance requires a Class A roof on all new residential structures, which should effectively reduce the amount of hail damage.

Data Limitations

Many hail-producing storms go unreported to the National Weather Service. Therefore, data collected for the purposes of this study may not be all-inclusive of major hail events experienced in El Paso County or the City of Colorado Springs.

4.5.2 Tornado

Hazard Description

The National Weather Service defines a tornado as a "violently rotating column of air extending from a thunderstorm to the ground." Tornadoes are the most violent of all atmospheric storms. Wind speeds can exceed 250 miles per hour, and damage paths can be more than one mile wide and 50 miles long. Prior to February 1, 2007, tornado intensity was measured by the Fujita Scale (F Scale). An updated and revised version of the Fujita scale is the Enhanced Fujita Scale (EF Scale). Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado.

Table 4-38: Tornado Intensity Scales

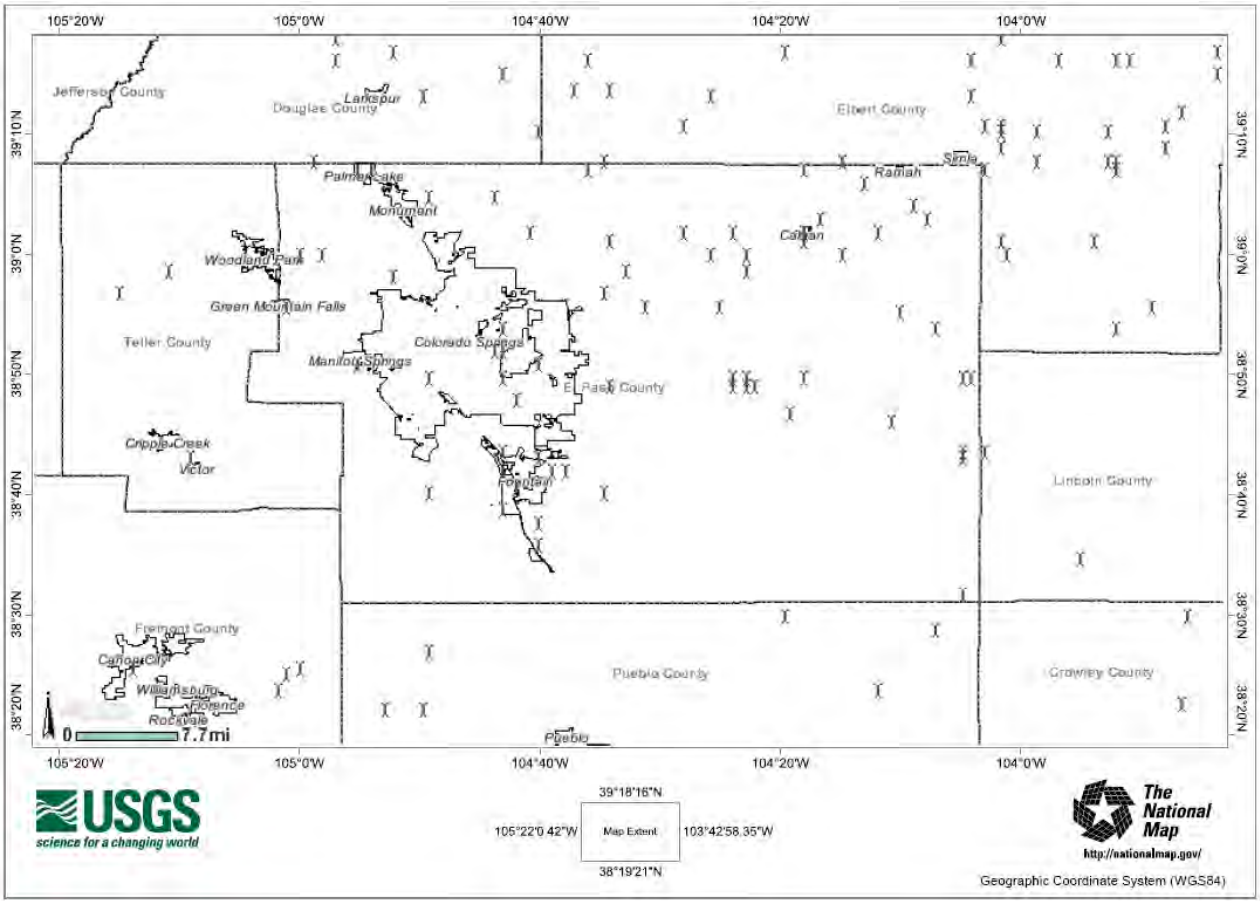
Intensity Category (F Scale)	Wind Estimate (3 Second Gust)	Intensity Category (Operational EF Scale)	Wind Estimate (3 Second Gust)	Typical Damage Impacts
F0	45-78 mph	EF0	65-85 mph	**Light damage:** Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	79-117 mph	EF1	86-110 mph	**Moderate damage:** Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	118-161 mph	EF2	111-135 mph	**Considerable damage:** Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	162-209 mph	EF3	136-165 mph	**Severe damage:** Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	210-261 mph	EF4	166-200 mph	**Devastating damage:** Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	262-317 mph	EF5	Over 200 mph	**Incredible damage:** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: NOAA Storm Prediction Center at http://www.spc.noaa.gov/faq/tornado/ef-scale.html and http://www.spc.noaa.gov/faq/tornado/f-scale.html, accessed 23 October 2009. Links verified for 2016 Plan.

Geographic Location

Tornadoes can occur anywhere in Colorado Springs and pose a similar risk to all areas within the city. Figure 4-37 shows recorded tornadoes from 1954-2004 from the USGS National Map Viewer. It is readily apparent that multiple tornadoes are recorded within the city limits of Colorado Springs.

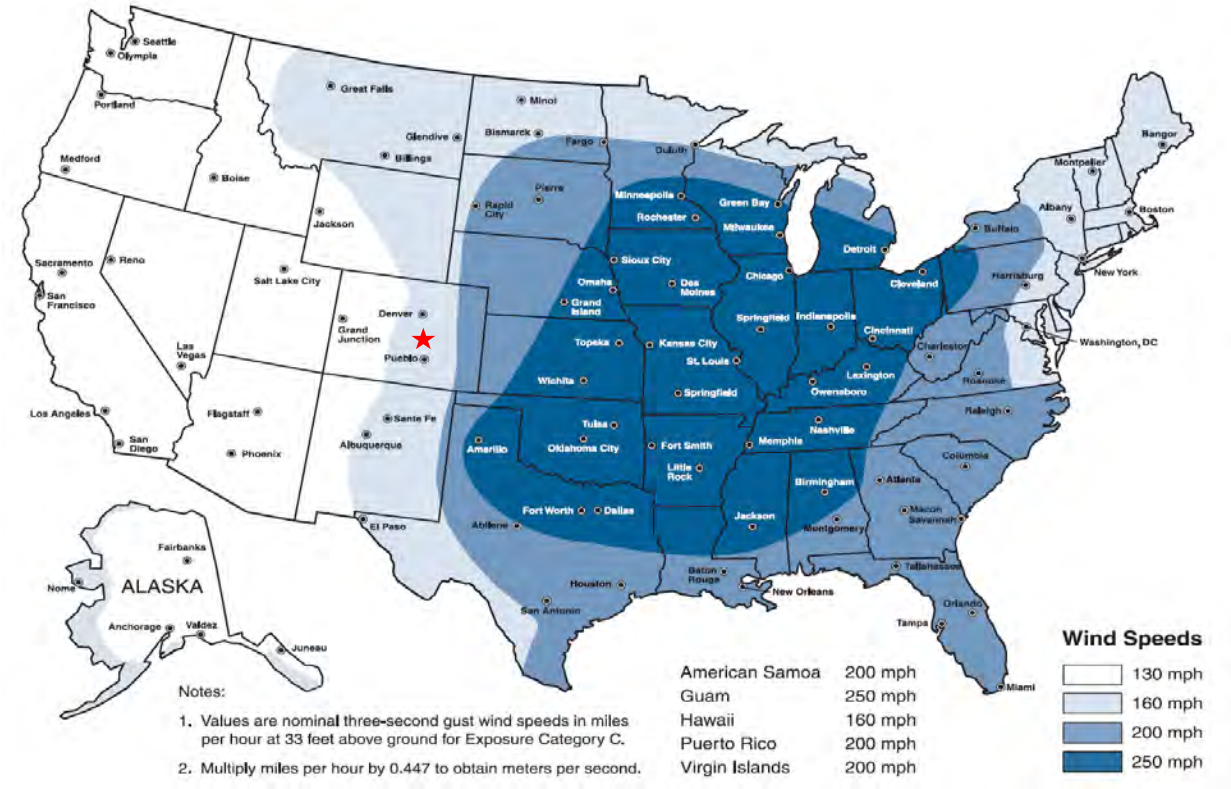
Figure 4-37: Tornadoes in Colorado Springs, El Paso County, 1954-2004



Source: USGS National Map Viewer, http://nmviewogc.cr.usgs.gov/viewer.htm accessed on February 4, 2010. 2016 Update: Link no longer operable. USGS no longer publishes this historic information on the National Map.

FEMA's map of Wind Zones in the United States shows Colorado Springs located in Wind Zone II with tornado winds of up to 160 mph. Figure 4-38 illustrates the Tornado Safe Room Design Speeds for the nation.

Figure 4-38: Tornado Safe Room Design Wind Speed Map



Source: http://www.fema.gov/plan/prevent/saferoom/fema361.shtm, accessed on November 15, 2009. Link verified for 2016 Plan.

Previous Occurrences

There were 87 tornadoes reported in El Paso County between 1950 and 2015. Table 4-39 is a list of some known tornadoes that either caused property damage or injuries/fatalities.

Table 4-39: Partial List of Tornadoes in Colorado Springs and El Paso County

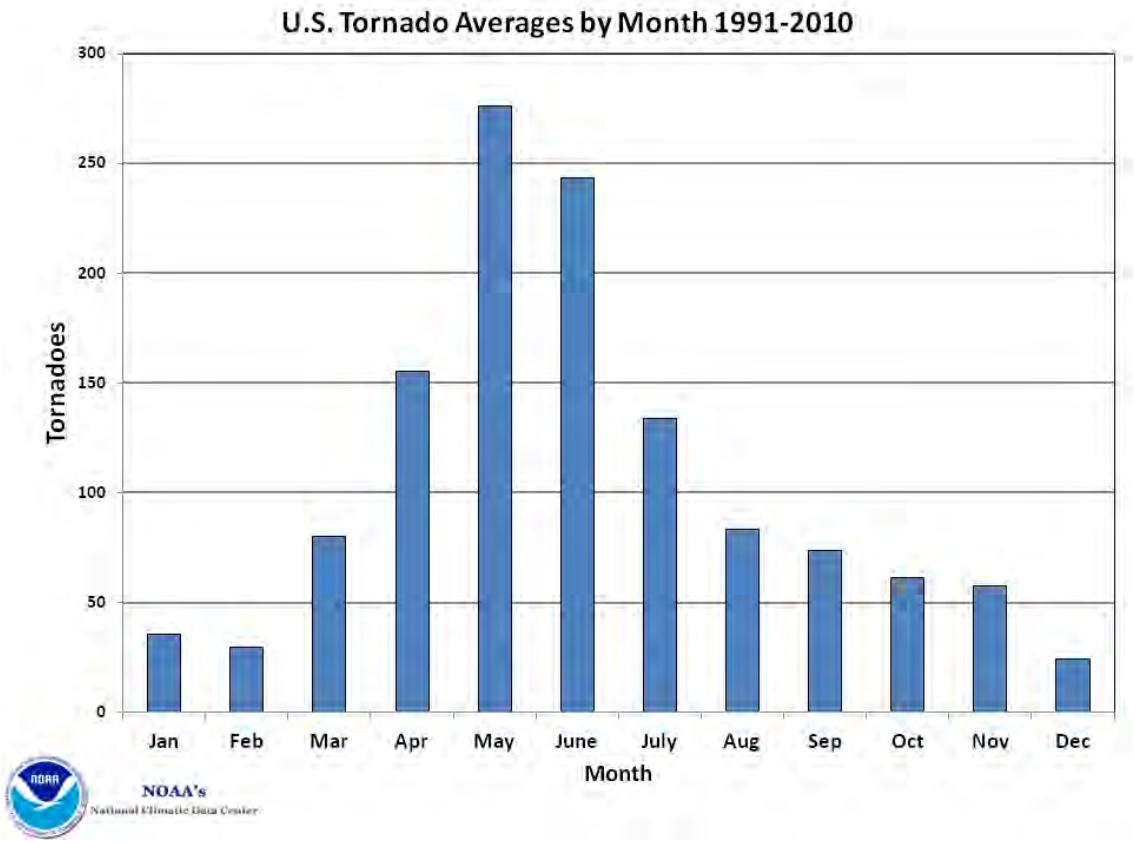
Date	Magnitude*	Injuries**	Fatalities**	Property Damage ($)**	Source
6/14/1951	F1			2,500	NCEI
6/2/1961				1,923	SHELDUS
6/22/1962				2	SHELDUS
6/17/1965				500	SHELDUS
5/28/1972				50	SHELDUS
4/11/1977	F2			250,000	SHELDUS/NCEI
6/13/1977	F2	2		250,000	SHELDUS/NCEI
6/24/1979	F3	1		250,000	SHELDUS/NCEI
6/9/1985	F1			25,000	NCEI
6/6/1990	F2	2		250,000	SHELDUS/NCEI
6/22/1995	F1			200,000	SHELDUS/NCEI

Date	Magnitude*	Injuries**	Fatalities**	Property Damage ($)**	Source
8/4/1995***	F0				NCEI
7/3/1998***	F0				NCEI
5/25/2000				5,000	SHELDUS
7/20/2000***	F0				NCEI
5/28/2001	F2	4		8,000,000	SHELDUS/NCEI
5/28/2001	F1	5		100,000	SHELDUS
5/28/2001	F2	4		20,000	SHELDUS
8/13/2008	F1			10,000	SHELDUS/NCEI
5/19/2011	EF0			20,000	NCEI
4/26/2012	EF0			10,000	NCEI
6/7/2012	EF1			50,000	NCEI
6/4/2015	EF1			2,000	NCEI

*Magnitudes before 2007, notated with F, are based on the Fujita Scale. Magnitudes after 2007, notated with EF, are based on the Enhanced Fujita Scale.
**Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. Damage, Injuries, and Fatalities are divided between the affected counties by any one documented disaster within the SHELDUS database.
***Data shows that tornado occurred in the City of Colorado Springs.

Figure 4-39 shows the number of tornadoes by month in the United States. Most tornadoes in the U.S. occur in the months of May and June. This is apparently evident in the Colorado Springs vicinity as well, as shown in Table 4-39.

Figure 4-39: U.S. Tornadoes by Month 1991-2010



Source: National Climatic Data Center, online at https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/trends, accessed on June 15, 2015.

Probability of Future Occurrence

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less.*

Based on the data available (87 tornadoes in 65 years), a tornado occurring in El Paso County is highly likely every year. There were at least three tornadoes that touched down in the City of Colorado Springs within the past 20 years. When extrapolated, one could assume that a tornado is expected to occur within Colorado Springs about once every six years, or there is a 15% chance of a tornado occurring in any given year.

Climate Change Impacts

The 2014 NCA shows how climate change may impact severe weather events like tornadoes, hail and damaging winds, but does not have the quality of data to determine how these storms might change in the future.

Magnitude/Severity

Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours.*

Most tornadoes in Colorado are weak with wind speeds of less than 110 miles per hour. Many tornadoes make landfall in the rural areas of El Paso County. However, should a tornado touch down within the city limits in a heavily populated area, the damage could be devastating.

Vulnerability Assessment

Overall Summary and Impacts: There are several significant tornadoes that have caused injuries and property damage in El Paso County in the past. It can be expected that history will repeat itself, and major tornadic events will continue to occur not only within the county, but within the City of Colorado Springs. Knowing when or how severe, is impossible to determine.

Identifying Structures and Estimating Potential Losses: Tornadoes can cause significant damage to structures, trees, utilities, crops, and have the potential to injure and kill people. Tornadoes affect the entire planning area, including all above-ground structures and utilities. Due to the erratic movement of tornadoes, destruction often appears random. There are no specific identified hazard areas as the entire city is susceptible to tornadoes. With advance warning, people can evacuate to safe rooms, or to more structurally sound areas within the building. Basements are considered one of the safest places to retire during a tornadic event.

Within five miles of the City of Colorado Springs, there are 32 Federal Communications Commission (FCC) FM towers, 28 FCC TV towers, and three FCC AM towers. These are utilities that could potentially be damaged or destroyed in a path of a tornado. In addition, there are roughly 110 miles of overhead transmission lines within the City of Colorado Springs. The possible destruction of these utilities, shown in Figure 4-40, can decrease the effectiveness of the community's ability to respond to emergencies.

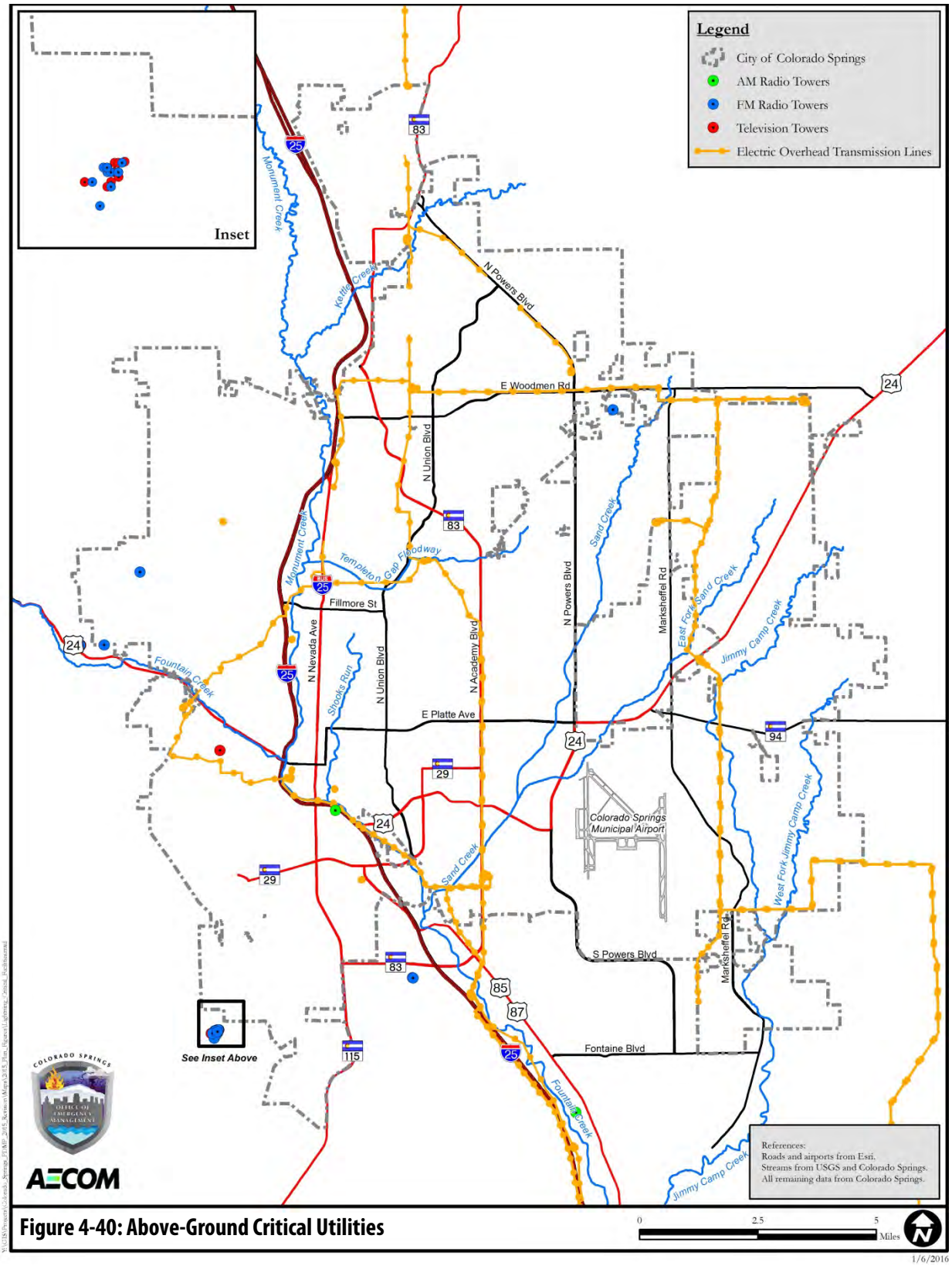


Figure 4-40: Above-Ground Critical Utilities

Also vulnerable are mobile home parks, where the lack of a sound foundation often results in complete devastation of these structures as they are whisked away from even the low-intensity tornadoes. Figure 4-42 shows the mobile home parks (953 acres) within the City of Colorado Springs.

Areas with large numbers of trees present additional vulnerability, as large trees can be uprooted and their limbs projected great distances. Figure 4-43 shows the areas in the City of Colorado Springs where tree densities are highest, and shows the locations of structures in those areas.

Figure 4-41: Tornado near Colorado Springs, ca. 1920s

Source: Pikes Peak Library District Special Collections Photo Archive, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=013-144-di-72.jpg;&view=1, accessed on November 30, 2009.

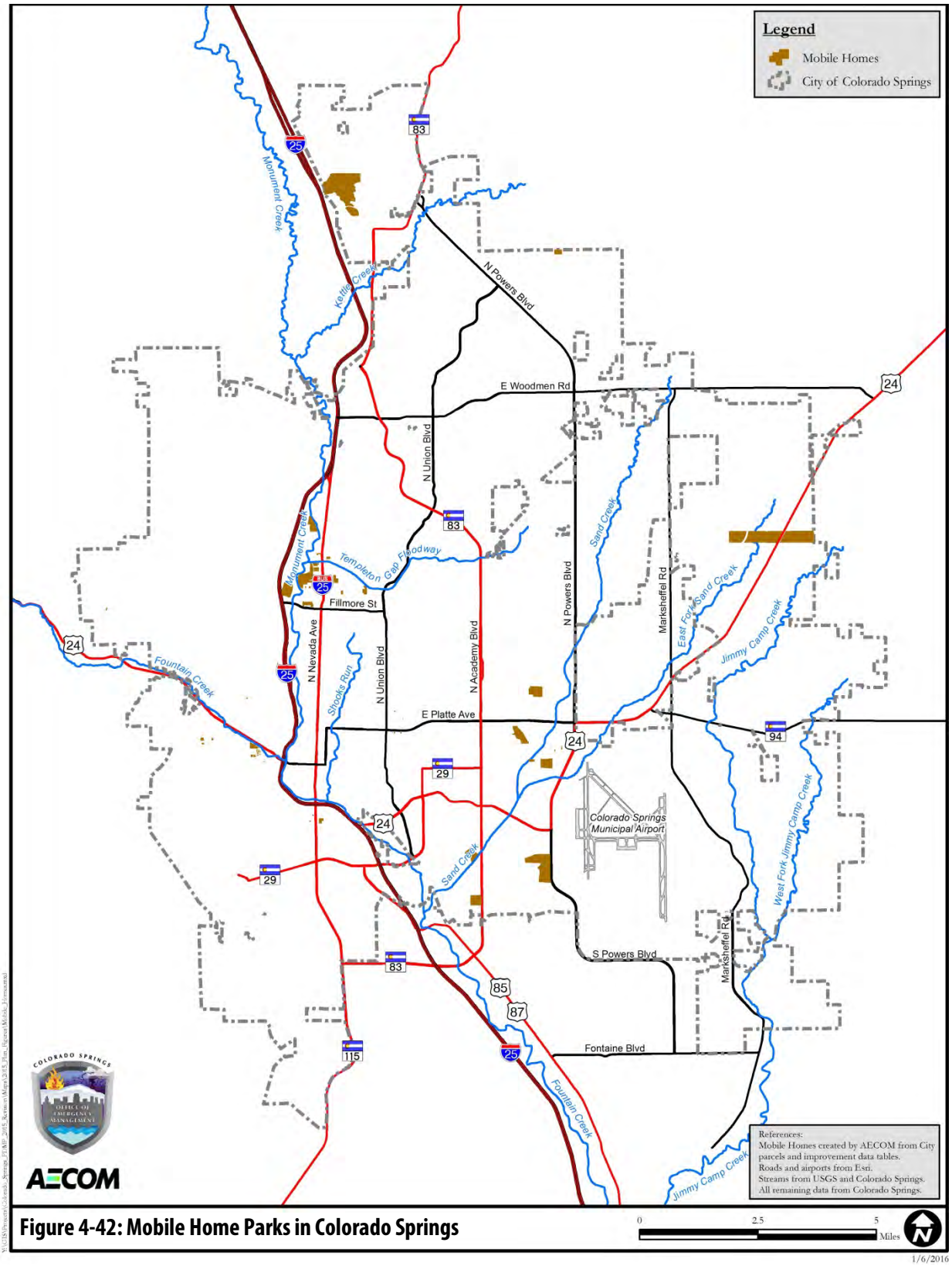


Figure 4-42: Mobile Home Parks in Colorado Springs

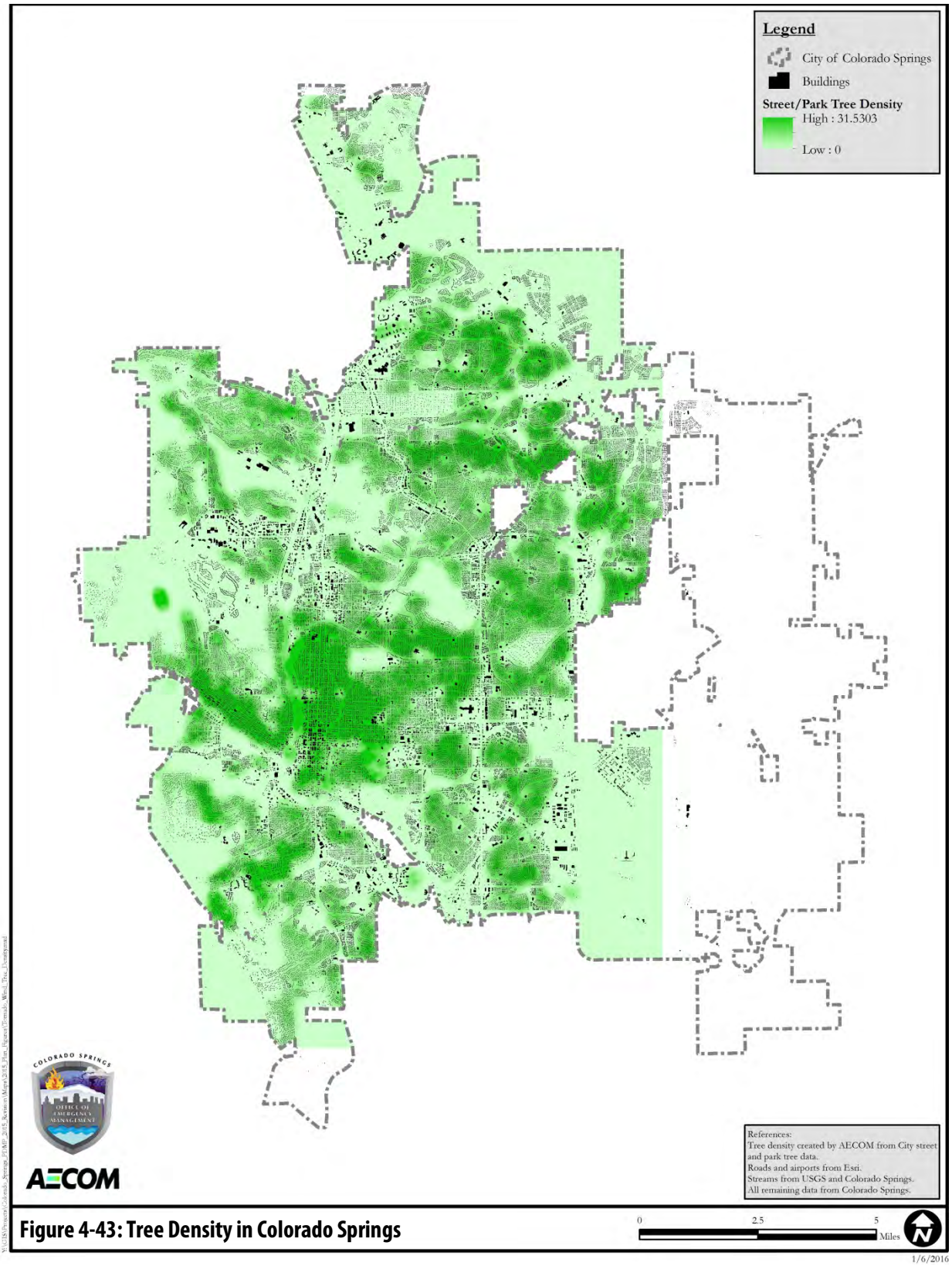


Figure 4-43: Tree Density in Colorado Springs

Secondary Impacts: The Colorado SEOP describes how a tornado can cause a HAZMAT incident if there is a fixed or mobile source of hazardous materials in the tornado path. A tornado can also cause mass casualties, trigger urban fires, and cause utility disruption.

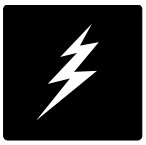
Future Development: Continuing development pressures along the Front Range will likely increase the overall vulnerability to tornadoes. Building codes in place can reduce the overall impacts; however, significant tornadoes are unpredictable and are capable of destroying buildings with incredible structural integrity. As the city grows, development to the east will be particularly more vulnerable to tornadoes, as most of the tornadoes recorded in the county occurred farther away from the foothills.

Data Limitations

Due to the isolated nature of tornadic storms, it is difficult to determine the vulnerability of specific areas. Tornado data is often collected by observations and many events are not reported to the National Weather Service or to other archiving agencies.

4.5.3 Lightning

Hazard Description



Lightning is an electrical discharge between positive and negative regions of a thunderstorm. It is sudden, extremely destructive and potentially deadly. Intracloud 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. Although not as common, cloud-to-ground lightning is the most damaging and dangerous form. Most flashes originate near the lower-negative charge center and deliver a negative charge to earth. However, a large minority of flashes carry a 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.

Geographic Location

Lightning can occur anywhere in Colorado Springs and poses a similar risk to all areas within the city.

Previous Occurrences

There were over 59 significant lightning events on record for Colorado Springs and vicinity since 1960. The NCEI listed 22 major lightning events occurring in Colorado Springs since 1996. One particularly damaging event occurred on August 29, 1996 when a lightning strike ignited an attic fire in an historic parish house at First Lutheran Church. This event caused roughly $200,000 in damage. In July 2007, a house caught fire in the Woodmen Subdivision due to lightning causing over $30,000 in damage. Lightning caused a house fire on the south side of Colorado Springs causing roughly $20,000 in damage and injuring a

firefighter. In June 2015, a lightning strike near the corner of East Woodmen Road and Tutt Boulevard injured five construction workers. On June 28, 2015, lightning knocked the power out at the El Paso County jail.[24]

Table 4-40: Partial List of Significant Lightning Events in El Paso County, Colorado

Date	Injuries*	Fatalities*	Property Damage ($)*	Source**
9/7/1960	1		50	SHELDUS
5/12/1962			172	SHELDUS
5/26/1962			50,000	SHELDUS
7/18/1962			25	SHELDUS
6/14/1963	0.67		1,667	SHELDUS
8/6/1963	0.07		172	SHELDUS
7/7/1964	1		0	SHELDUS
8/5/1964	1.1		0	SHELDUS
8/16/1972	1	2	0	SHELDUS
8/28/1973	1		0	SHELDUS
6/1/1974	1		0	SHELDUS
6/27/1974	2		0	SHELDUS
6/7/1975	1		0	SHELDUS
7/27/1977		1	0	SHELDUS
7/2/1980			50,000	SHELDUS
8/9/1982		1	0	SHELDUS
5/18/1985		1	0	SHELDUS
3/5/1990			166,667	SHELDUS
6/2/1995	1		0	SHELDUS
7/1/1995	1	1	0	SHELDUS
7/9/1995	1	1	0	SHELDUS
6/12/1996			70,000	SHELDUS
7/10/1996	1		0	SHELDUS/NCEI
7/20/1996		1	0	SHELDUS/NCEI
8/29/1996			200,000	SHELDUS/NCEI
9/10/1996	1		0	SHELDUS/NCEI
6/6/1997	1		0	SHELDUS/NCEI
7/6/1997		1	0	SHELDUS
7/6/1998			50,000	SHELDUS/NCEI
7/10/1998			85,000	SHELDUS/NCEI
8/19/1998	1		0	SHELDUS

[24] Denver Post at http://www.denverpost.com/news/ci_28375106/colorado-springs-lightning-strike-injures-4-at-construction and Colorado Springs Gazette at http://gazette.com/repeated-lightning-strikes-zap-colorado-springs/article/1554628, June 29, 2015

Date	Injuries*	Fatalities*	Property Damage ($)*	Source**
5/24/1999	4		0	SHELDUS/NCEI
8/19/1999	8		0	SHELDUS/NCEI
7/20/2000			5,000	SHELDUS
7/25/2000		1	0	SHELDUS/NCEI
7/28/2000	1		0	SHELDUS
8/2/2000			75,000	SHELDUS/NCEI
5/30/2001	3	1	0	SHELDUS
7/12/2001			20,000	SHELDUS/NCEI
7/13/2001			100,000	SHELDUS/NCEI
8/5/2001	1		0	SHELDUS/NCEI
7/13/2003	1		0	SHELDUS
7/25/2003	1		0	SHELDUS
8/5/2003		1	0	SHELDUS
8/23/2003	3		0	SHELDUS/NCEI
6/26/2004			3,000	SHELDUS
7/19/2006	1		0	SHELDUS/NCEI
5/22/2007	1		0	SHELDUS/NCEI
6/2/2007	1		0	SHELDUS
6/4/2007			3,000	SHELDUS/NCEI
7/10/2007			30,000	SHELDUS/NCEI
9/2/2007	3		0	SHELDUS/NCEI
6/24/2008	2		0	SHELDUS/NCEI
7/1/2009			3,000	NCEI
7/27/2009			200,000	NCEI
8/6/2009			20,000	NCEI
7/10/2010	1		0	NCEI
7/24/2011	5		0	NCEI
7/30/2012			30,000	NCEI
7/31/2013	12		0	NCEI
6/25/2014			1,000	NCEI
7/4/2014			50,000	NCEI
6/4/2015	5		0	NCEI

* Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. Damage, Injuries, and Fatalities are divided between the affected counties by any one documented disaster within the SHELDUS database.
** Data from NCEI listed event as Colorado Springs for location identification.

In addition, CSFD tracks dispatch data regarding all their responses. Table 4-41 contains the number of incidents that CSFD responded to that were dispatched as lightning strikes.

Table 4-41: Dispatched Lightning Strike Responses, CSFD 1993-2009

Year	Number of Lightning Strike Dispatches	Year	Number of Lightning Strike Dispatches
1993	33	2002	23
1994	70	2003	21
1995	45	2004	48
1996	56	2005	22
1997	34	2006	66
1998	46	2007	44
1999	59	2008	4
2000	67	2009	36
2001	58		

Source: Data provided by email from Bill Wallace, CSFD on January 4, 2010. Updated data was not available for the 2016 Plan.

Probability of Future Occurrence

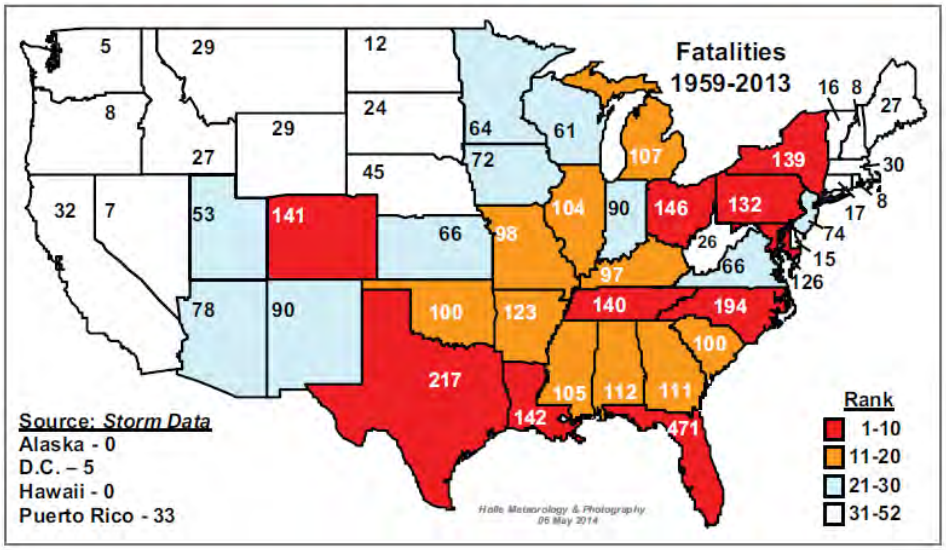
Highly Likely: *Near 100% chance of occurrence next year or every year.*

According to the historical data, a significant lightning event occurs within Colorado Springs nearly every year. There were 22 events recorded in 18 years in the city and 63 events recorded since 1960 in the county. Either scenario presents a probability of greater than one. Figure 4-44 illustrates the number of lightning related fatalities by state from 1959-2013. Colorado (141 fatalities) ranked 6th in the U.S., following Louisiana (142), Ohio (146), North Carolina (194), Texas (217), and Florida (471) in lightning deaths.

Climate Change Impacts

The 2014 NCA shows how climate change may impact severe weather events like tornadoes, hail and damaging winds but does not have the quality of data to determine how these storms might change in the future.

Figure 4-44: U.S. Lightning Fatalities shown by State, 1959-2013



Source: NOAA's lightning safety site, http://www.lightningsafety.noaa.gov/stats/59-13_State_Ltg_Fatalities.pdf, accessed on June 14, 2015.

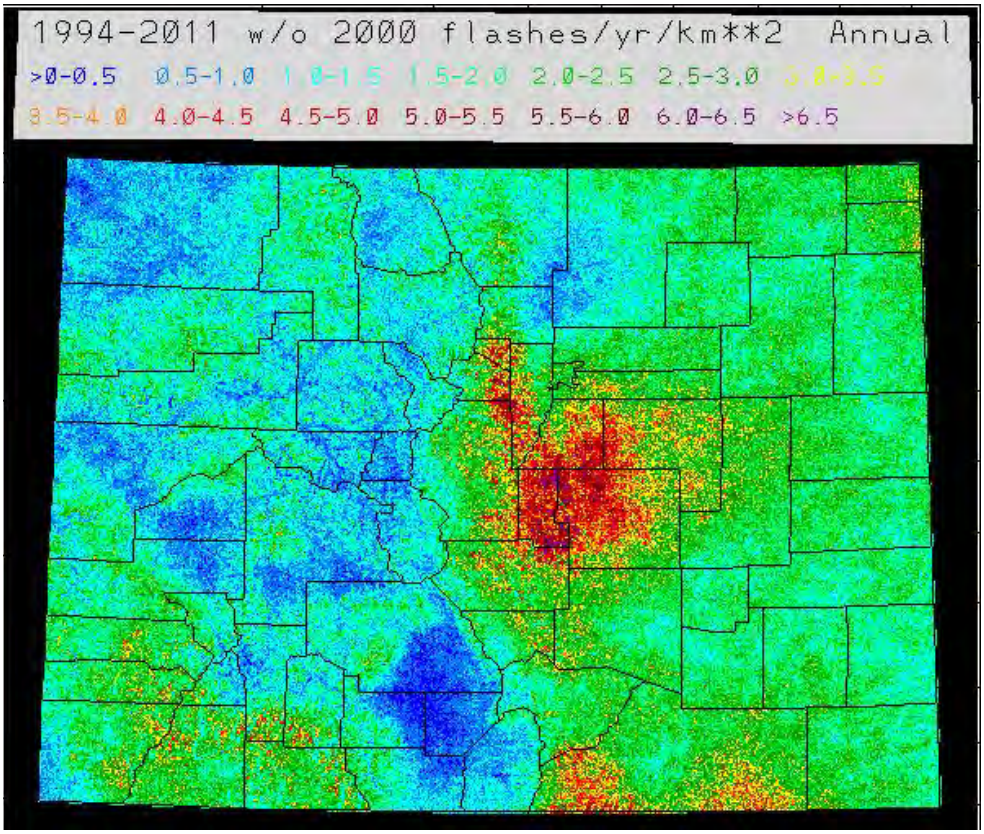
Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours.*

Although the frequency of lightning events is relatively high, the magnitude is limited. Generally damage is limited to single buildings and in most cases, personal hazard insurance covers any losses. Lightning can cause deaths, injuries, and property damage, including damage to buildings, communications systems, power lines, and electrical systems. It also causes forest and brush fires.

According to the National Weather Service, the State of Colorado ranks fourth nationally, behind Arkansas, New Mexico, and Wyoming, with a death rate of 0.82 per one million people.[25] Figure 4-45 illustrates average flash densities of the contiguous United States from 1994 to 2011. This shows Colorado Springs being somewhere between 3 to 4 flashes per square kilometer per year. The reason for the discrepancy between Colorado's low lightning flash density and high casualty rate is that many people participate in popular outdoor activities such as hiking and camping in the exposed, lightning-prone high country.

Figure 4-45: Cloud-to-Ground Lightning Incidents, 1994-2011



Source: NOAA's lightning safety site, http://www.weather.gov/images/pub/lightning/annual.jpg, accessed on June 14, 2015.

[25] National Weather Service, "Lightning Deaths by State and Deaths Population Weighted: 1959-2013," http://www.lightningsafety.noaa.gov/stats/59-13_State_Ltg_Fatalities.pdf, accessed June 14, 2015.

Vulnerability Assessment

Overall Summary and Impacts: Lightning has the potential to injure or kill people and damage structures either directly or by subsequent wildfire. Communications systems are also at risk. The City of Colorado Springs is certainly vulnerable to future lightning strikes judging by historical evidence. As a gateway into National Forest Land, the vast recreation opportunities in and around Colorado Springs place hikers, bikers, campers, among others at risk during major electrical storms. The City of Colorado Springs manages 14,000 acres of open space, 146 miles of urban trails, and 145 neighborhood parks.[26] In addition, there are thousands of acres of golf course land within the City of Colorado Springs. On a typical day, over one hundred golfers could be playing at any given moment.[27] The City also has more than 250 acres of cemeteries, where people are often in the open, exposed to the elements. All of these areas are typical locations where injuries and/or deaths result from major lightning events. Figure 4-46 shows the open space, golf courses, cemeteries, and parks within the City of Colorado Springs and the vicinity.

[26] City of Colorado Springs website, https://parks.coloradosprings.gov/explore-play/explore/information/about-parks-recreation-cultural-services, accessed June 15, 2015

[27] Based on two foursomes per hole on an 18-hole golf course, +/-.

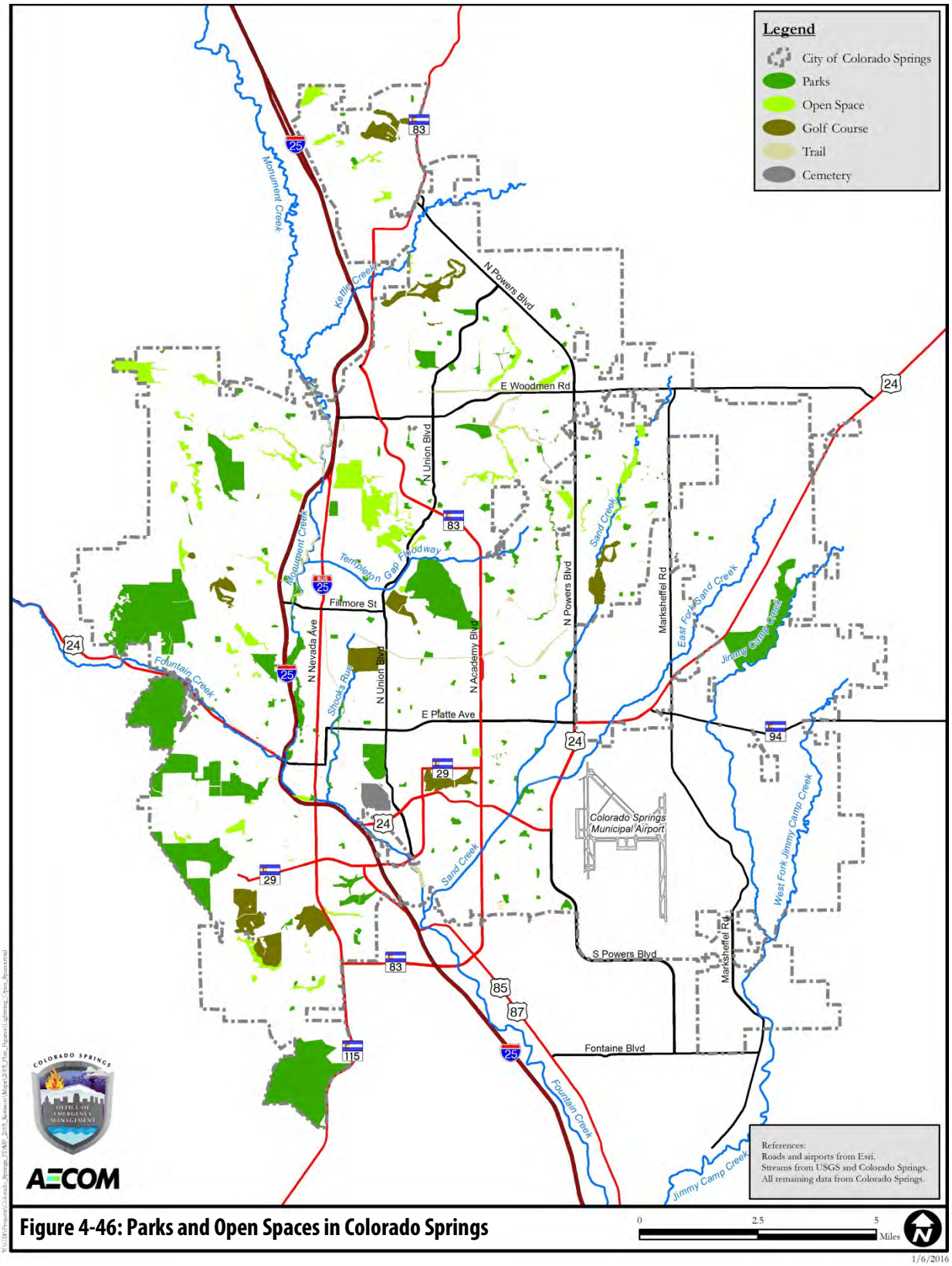


Figure 4-46: Parks and Open Spaces in Colorado Springs

Identifying Structures and Estimating Potential Losses: Lightning affects the entire planning area, including all above-ground structures and utilities. Structure damage due to lightning is usually covered under private insurance. Personal injury can also occur as a result of lightning if individuals are outdoors. Damage and injuries caused by lightning are typically the result of ensuing fires. From 1993 to 2009, there were 219 fires ignited by lightning.[28] Updated data on fires ignited by lightning was not available for the 2016 Plan.

Within five miles of the City of Colorado Springs, there are 32 FCC FM towers, 28 FCC TV towers, and 3 FCC AM towers. These are utilities that could potentially be struck by and affected by lightning storms. In addition, there are roughly 110 miles of overhead transmission lines within the City of Colorado Springs. Above-ground utilities related to critical communications and transmission are depicted in Figure 4-48.

Secondary Impacts: The Colorado SEOP does not list any secondary impacts from lightning but it is possible it could cause a utility disruption or secondary impacts related to power failure and urban fires.

Future Development: Building standards can offer only limited protection from lightning damage. Lightning rod/grounding systems can improve the performance of a building during such an event. Fire codes in place result in less structure damage caused by lightning-sparked fires. Increasing population growth and development increases vulnerability to lightning.

Data Limitations

Although national weather centers keep excellent records of previous events, it should be noted that many lightning events often go unreported to the National Weather Service.

4.5.4 Windstorm

Hazard Description

Windstorms represent the most common type of severe weather. Often accompanying severe thunderstorms (convective windstorms), they can cause significant property and crop damage, threaten public safety and disrupt utilities and communications. Straight-line winds are generally any wind not associated with rotation and in rare cases can exceed 100 miles per hour (mph). The National Weather Service defines high winds as sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. Windstorms are often produced by super-cell thunderstorms or a line of thunderstorms that typically develop on hot and humid days.

Along the Colorado Front Range, the foothills areas are also susceptible to Chinook winds, which are caused by the large temperature variations between the northern and southern United States during the winter. These winds plow down the slopes of the Front Range at speeds ranging from 60 to 100 mph. Chinook winds can down power lines, overturn cars, produce flying debris, and reduce visibility.[29]

[28] Data provided by email from Bill Wallace, CSFD on January 4, 2010.

[29] National Weather Service High Wind Safety webpage, at http://www.weather.gov/bou/highwind, on October 29, 2015

Geographic Location

Windstorms can occur virtually anywhere in the City of Colorado Springs with equal probability and magnitude.

Previous Occurrences

More than 100 major wind events were reported in El Paso County since 1960, some of which are listed in Table 4-42. One major storm produced winds up to 60 mph ripping off large tree limbs and partially peeling the roof from the El Paso County Courthouse in downtown Colorado Springs. This event took place on June 26, 2009. Power to 1,300 customers was lost for a short time and one contractor was slightly injured at the Courthouse. A storm on March 10, 1977, was said to have killed five people and caused more than $170,000 in damage. A strong wind shear of 100 mph hit southwest Colorado Springs in 2004, damaging roofs and generating projectiles. Winds in excess of 85 mph impacted western portions of Colorado Springs in December 2010; breaking windows, damaging roofs, downing trees, and causing power outages. One truck was overturned in the City but the driver was not injured.

Table 4-42: Partial List of Significant Wind Events in Colorado Springs and Vicinity

Date	Injuries**	Fatalities**	Property Damage ($)**	Source*
2/12/1960	6		5,000	SHELDUS
4/16/1960	0.08		794	SHELDUS
12/21/1961	0.14		172	SHELDUS
1/8/1962		0.16	7,937	SHELDUS
2/12/1962	6		5,000	SHELDUS
3/28/1962			17	SHELDUS
4/7/1962	0.02		781	SHELDUS
12/15/1964			19,231	SHELDUS
12/21/1964			19,231	SHELDUS
6/16/1965			500	SHELDUS
3/3/1966			333	SHELDUS
2/13/1967			1,667	SHELDUS
4/6/1969	0.02		79	SHELDUS
10/11/1969	0.03		794	SHELDUS
11/30/1970			794	SHELDUS
12/23/1971			5,000	SHELDUS
4/26/1972			33,333	SHELDUS
6/23/1975			50,000	SHELDUS
11/17/1975		0.02	11,364	SHELDUS
3/10/1977	0.03	5	172,414	SHELDUS
12/2/1977	1		4,545	SHELDUS
8/14/1978			4,167	SHELDUS
3/29/1982			1,786	SHELDUS
4/2/1982	5		178,571	SHELDUS
5/16/1983			26,316	SHELDUS

Date	Injuries**	Fatalities**	Property Damage ($)**	Source*
4/19/1984			794	SHELDUS
2/15/1986			500,000	SHELDUS
9/24/1986	0.02		7,937	SHELDUS
1/28/1987	0.10		238,095	SHELDUS
1/23/1988	0.12		19,231	SHELDUS
5/1/1988			12,500	SHELDUS
5/2/1988			16,667	SHELDUS
9/18/1988			31,250	SHELDUS
1/9/1989			45,455	SHELDUS
3/14/1989	0.03		12,821	SHELDUS
1/8/1990			2,941	SHELDUS
12/14/1990	0.25		31,250	SHELDUS
3/11/1991	1		1,563	SHELDUS
8/12/1993				NCEI
5/19/1994				NCEI
7/3/1995				NCEI
2/22/1996	1		66,667	SHELDUS
4/19/1996			100,000	SHELDUS
6/21/1996			40,000	SHELDUS
6/23/1996				NCEI
7/20/1996				NCEI
10/29/1996			35,714	SHELDUS
12/5/1996			33,333	SHELDUS
6/6/1997				NCEI
8/4/1997				NCEI
10/11/1997			10,714	SHELDUS
6/21/1998				NCEI
2/2/1999			10,000	SHELDUS
2/10/1999			10,000	SHELDUS
2/22/1999			2,333	SHELDUS
4/8/1999			1,737	SHELDUS
4/18/2000			625	SHELDUS
5/17/2000			1,667	SHELDUS
6/19/2000				NCEI
7/7/2000				NCEI
5/20/2001				NCEI
5/28/2001	7		400,000	SHELDUS
6/22/2001				NCEI
10/1/2001				NCEI

Date	Injuries**	Fatalities**	Property Damage ($)**	Source*
1/2/2004			50,000	SHELDUS/2005 PDM Plan
8/4/2004				NCEI
11/3/2005			33,333	SHELDUS
5/22/2006				NCEI
8/6/2007				NCEI
12/30/2008			666,667	SHELDUS
6/26/2009	1			NCEI
7/29/2009				NCEI
4/1/2010				NCEI
5/24/2010			30,000	NCEI
12/3/2010				NCEI
12/20/2010				NCEI
1/22/2011				NCEI
4/3/2011				NCEI
4/9/2011				NCEI
10/6/2011				NCEI
11/12/2011			750,000	NCEI
12/31/2011				NCEI
1/18/2012				NCEI
2/22/2012				NCEI
2/29/2012				NCEI
3/26/2012				NCEI
4/2/2012				NCEI
4/3/2012				NCEI
1/11/2013				NCEI
12/2/2013				NCEI
1/30/2014				NCEI
2/15/2014				NCEI
3/18/2014				NCEI
3/31/2014				NCEI
4/29/2014				NCEI
12/23/2014				NCEI

*Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. All events from NCEI were listed as occurring in Colorado Springs.

**Damage, Injuries, and Fatalities are divided between the affected counties by any one documented disaster within the SHELDUS database.

Figure 4-47: Multiple Trees Uprooted in a Colorado Springs Windstorm, 1900

Source: Pikes Peak Library District Photo Archives, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=001-3533-di-72.jpg;&view=1, accessed on November 30, 2009.

Probability of Future Occurrence

Highly Likely: *Near 100% chance of occurrence next year or every year.*

The 96 major wind events listed in Table 4-42 since 1960 indicate that a major wind event will occur every year in Colorado Springs, or 1.7 per year.

Climate Change Impacts

The 2014 NCA shows how climate change may impact severe weather events like tornadoes, hail and damaging winds but does not have the quality of data to determine how these storms might change in the future.

Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours*

Any structures and above ground utilities are vulnerable to damage caused by major wind events. Major wind events can cause downed trees and power lines, damage to structures and fences, and send dangerous debris into the air leading to more damage, injuries, and potential deaths.

Vulnerability Assessment

Overall Summary and Impacts: Predicting a major wind storm is nearly impossible; however, it is expected that major wind events will occur every year. Damage from winds is primarily to structures, trees, utilities, and crops. Streets lined with older, unstable trees present a specific hazard to passersby, structures, and automobiles.

Identifying Structures and Estimating Potential Losses: Data is not currently available that identify specific costs for an individual event within the City of Colorado Springs.

Within five miles of the City of Colorado Springs, there are 32 FCC FM towers, 28 FCC TV towers, and three FCC AM towers. These are utilities that could potentially be damaged or destroyed during a major wind event. In addition, there are roughly 110 miles of overhead transmission lines within the City of Colorado Springs. As with tornadoes and lightning, severe windstorms can impact these overhead utilities (Figure 4-48).

One of the largest dangers resulting from major windstorms is fallen trees or debris. Fallen branches can destroy automobiles, damage structures, and cause major injury or death to individuals. The City Forestry Department maintains over 118,500 trees within the city limits. Through the 2008 Forestry Management Plan (most recent), and by City ordinance, the City Forestry Division is responsible for maintaining the overall health of the City's forests and taking necessary abatement actions when appropriate. Figure 4-49 and Figure 4-50 are maps of the tree density and forest canopy, respectively, within the City of Colorado Springs. On Figure 4-49, notice the density of structures within the areas of the City with the highest densities of tree cover. These areas are particularly vulnerable during major wind events. In addition, according to assessor's parcel data, there are 5,816 parcels within the City of Colorado Springs where the 'Year-built' of the structure on record is over 100 years old. Older buildings are typically more vulnerable to major wind events.

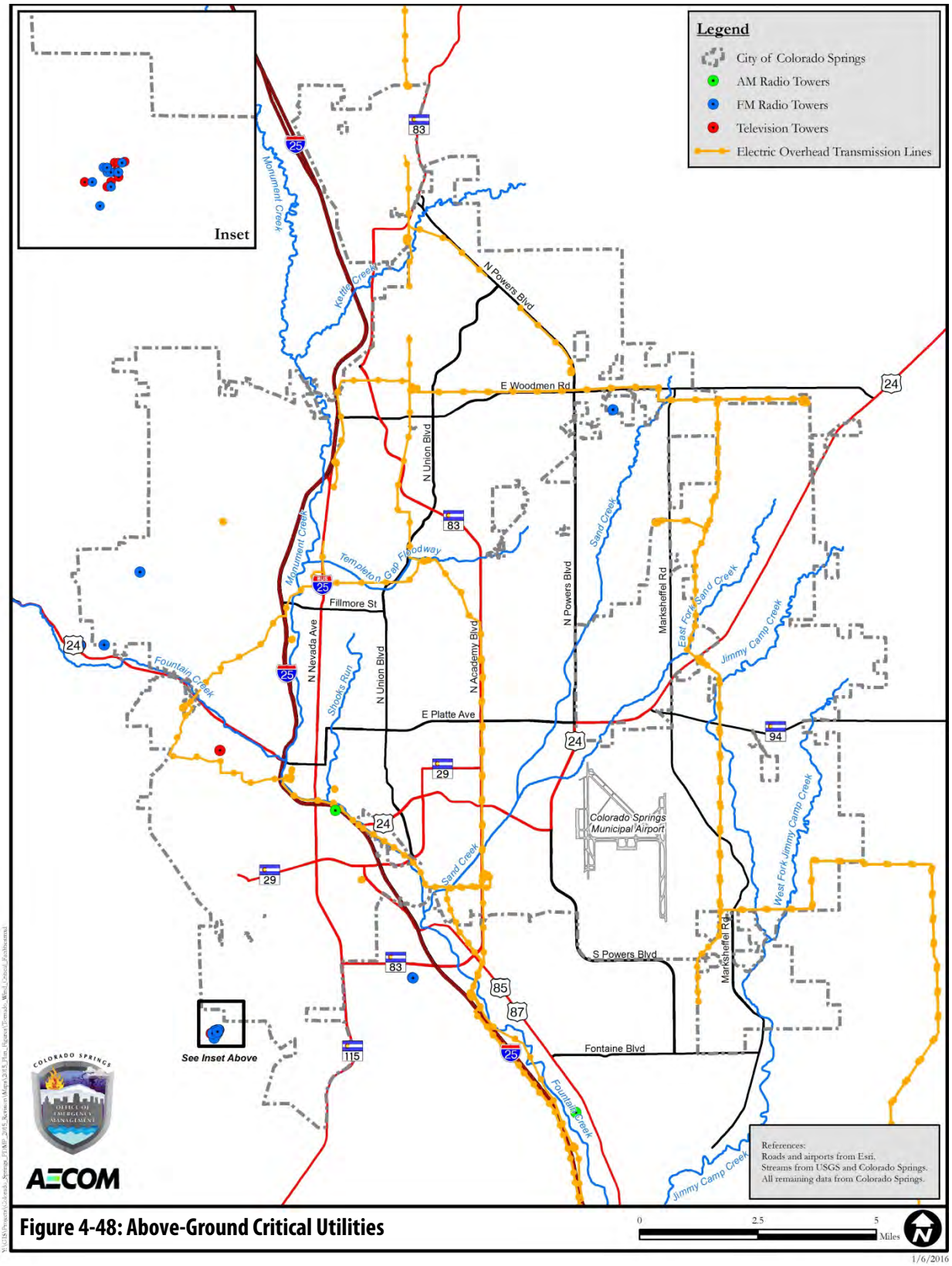


Figure 4-48: Above-Ground Critical Utilities

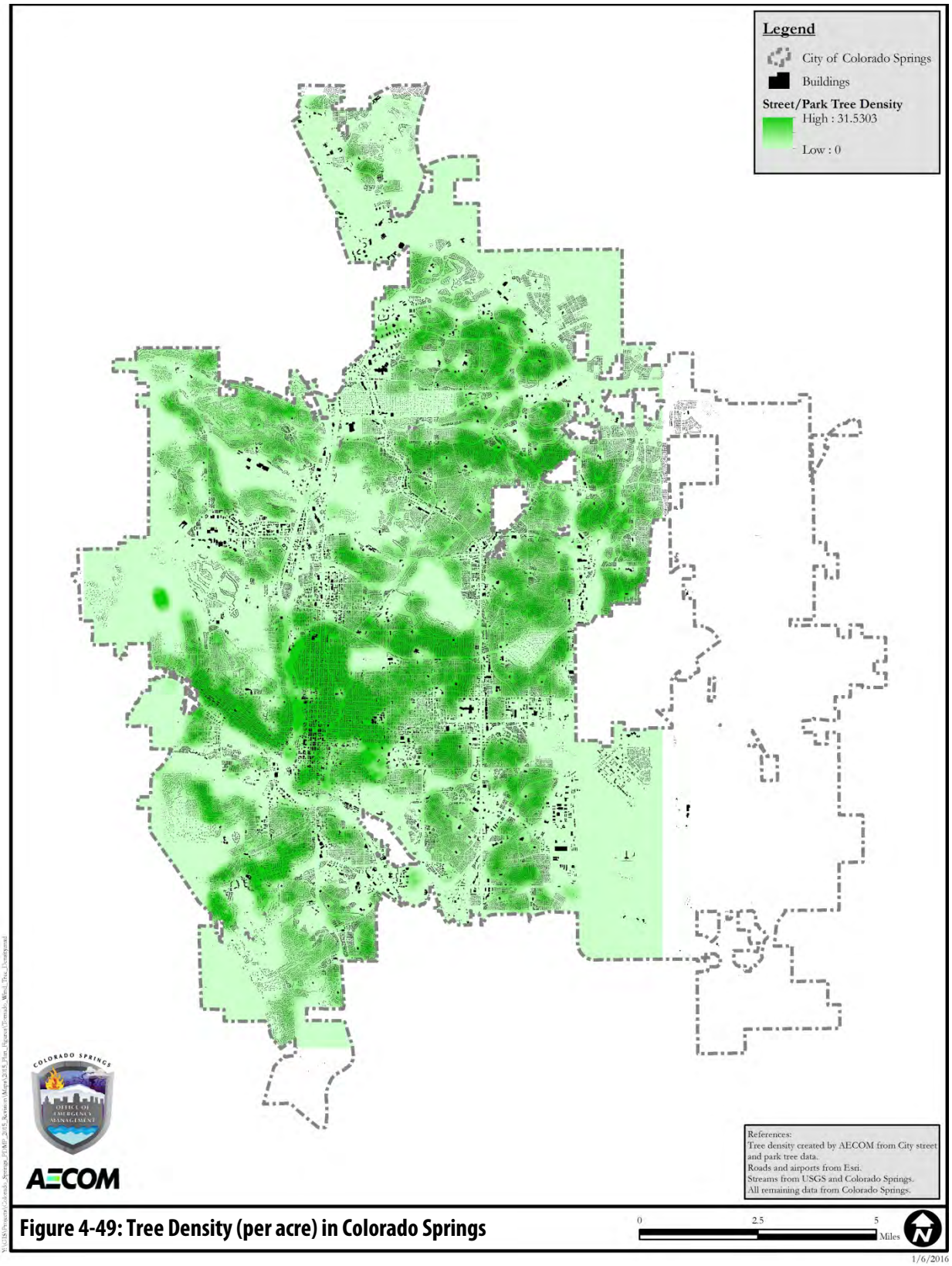
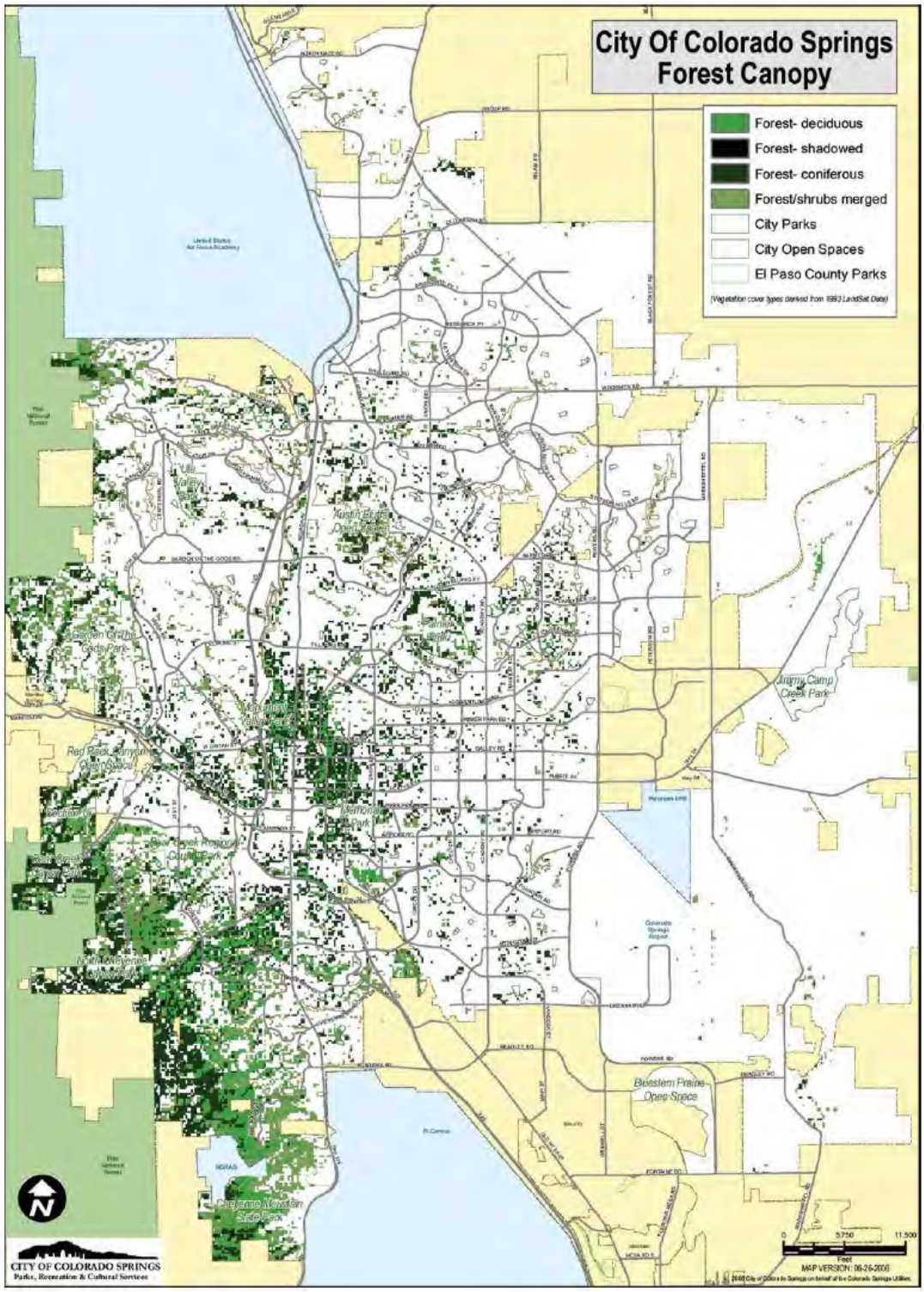


Figure 4-49: Tree Density (per acre) in Colorado Springs

Figure 4-50: City of Colorado Springs Forest Canopy



Source: City of Colorado Springs Forest Management Plan 2008, online at http://www.springsgov.com/Page.aspx?NavID=1207, accessed on January 22, 2010.

Secondary Impacts: The Colorado SEOP does not list windstorm in its list of hazards causing secondary impacts but they would be similar to that of a tornado with potential impact on a HAZMAT facility, utility disruption and cause urban fires.

Future Development: Building codes help to diminish potential damage to future structures during a major wind event. However, as development continues, the overall vulnerability to windstorms will increase.

Data Limitations

Major wind storms are often secondary affects during other severe weather events. Therefore, many major windstorms are not classified as such. Also, major wind events often go unreported to the National Weather Service or to other archiving agencies.

4.5.5 Winter Storm

Hazard Description

Severe winter storm hazards may include snow, ice, blizzard conditions, and extreme cold. Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Extreme cold often accompanies or follows a winter storm.

Geographic Location

Winter Storms can occur anywhere in the City of Colorado Springs, and would typically affect the entire city with equal severity.

Figure 4-51: Major Snow Storm in 1913, View on Pikes Peak Avenue

Source: Pikes Peak Library District Special Collections Photo Archives, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=013-145-di-72.jpg;&view=1, accessed on November 30, 2009.

Table 4-43 indicates that from 1948-2015, as recorded at the Colorado Springs WSO AP weather station, the coldest month on average is January, with an average minimum temperature of 16.6°F and maximum of 42.6°F. The highest annual snowfall was 89.4 inches during the winter of 1956-1957, which included 42.7 inches during April 1957. The coldest temperature on record was -27°F on February 1, 1951.

Table 4-43: Colorado Springs Winter Weather Summary

Station	Winter Average Maximum (°F)	Winter Average Minimum (°F)	Extreme Minimum Temperature/ Date	# Days Max Temp <32°F /Year	Average Annual Snowfall (inches)	Snowiest Month/ Average Inches
Colorado Springs WSO AP	43.8	17.9°	-27°/ February 1, 1951	25	39.0	March/8.3

Source: Western Regional Climate Center, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co1778, accessed June 14, 2015.

Previous Occurrences

There have been 78 severe winter storms recorded in El Paso County, many of which directly impacted Colorado Springs. Table 4-44 shows the results from the SHELDUS database for storms from 1960 to 2005. In addition, the NCEI listed 45 major winter storm events since 2005. The 2013 State Mitigation Plan included significant winter storm events from 1960–2013 in El Paso County. Those storms reported specifically for Colorado Springs are included in Table 4-44. During that time 61 winter storms were reported with 9 associated deaths, 3 injuries, and total damage in excess of six million dollars.

Table 4-44: Significant Winter Storms in Colorado Springs and Vicinity 1960 - August 2015 (SHELDUS* and 2013 State Mitigation Plan)

Date	Injuries**	Fatalities**	Property Damage ($)**
1/14/1960			12
2/20/1960			22
4/30/1960			0
1/10/1963			79
4/18/1966			79
4/13/1967	0.07	1	185
4/20/1967			0
5/1/1967			0
10/13/1969			0
9/16/1971			794
2/19/1976		0.02	0
11/10/1978		0.06	0
12/5/1978		0.02	0
11/19/1979	0.02		794
3/27/1980			1,667
3/31/1980			16,667
3/31/1980			1,667

Date	Injuries**	Fatalities**	Property Damage ($)**
3/4/1981			14
2/1/1982	1		79
12/23/1982		0.1	793,651
3/14/1983			794
12/20/1983			21,739
10/15/1984	0.02	0.02	11,111
1/30/1985		0.08	794
1/31/1985			794
9/28/1985			2,632
12/8/1985	0.05		2,632
10/10/1986			847
1987***			587,000
2/1/1989	0.32		79,365
2/1/1989	0.05		794
3/23/1990			10,000
3/2/1992	0.02		1,064
3/8/1992			3,571
1/26/1994		1	0
10/24/1997	0.29	0.71	171,429
2/18/1998		1	0
4/2/2001			24,000
4/11/2001			4,000,000
4/5/2005			250,000
1/28/2005			0
10/10/2005			0
1/19/2006			0
11/28/2006			0
12/20/2006			0
4/12/2007			0
3/26/2009			0
3/23/2010			0
2/2/2012			0
2/21/2015			0

*Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically. All events from NCEI were listed as occurring in Colorado Springs.

**Damage, Injuries, and Fatalities are divided between the affected counties by any one documented disaster within the SHELDUS database.

***According to the 2013 Colorado State Mitigation Plan.

Probability of Future Occurrence

Highly Likely: *Near 100% chance of occurrence next year or every year.*

The data indicates that there have been 61 severe winter storm events since 1960, or approximately 1.1 times per year. It is expected that a severe winter storm will occur every year in Colorado Springs or in the vicinity.

Climate Change Impacts

The 2014 NCA projects, based on the increased frequency and intensity of winter storms and that their tracks have shifted northward of the U.S., that this trend will continue. Both Boston in 2015 and the Midwestern United States in 2013-2014 experienced multiple severe winter storms in one winter season which resulted in record snowfalls and/or temperature extremes. The effects of these storms ranged from health risk to transportation disruptions. On one day (May 9, 2015), Colorado Springs was under five different severe weather or flooding warnings/advisories (tornado, severe thunderstorms, flooding, flash flooding, and winter weather).

Magnitude/Severity

Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours*

Heavy snow can immobilize a region by stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and tear down trees and power lines. Loss of power affects homes, businesses, and water, sewer, and other services operated by electric pumps. The cost of snow removal, damage repair, and business losses can be significant.

Heavy accumulations of ice and or strong winds can bring down trees, power lines, telephone poles and lines, and communication towers, causing communication disruptions that can last for days or weeks. Blowing snow can severely reduce visibility. Serious vehicle accidents can result with injuries and deaths. Prolonged exposure to the cold can cause frostbite or hypothermia and can become life-threatening; infants and the elderly are most at risk.

Vulnerability Assessment

Overall Summary and Impacts: Winter storms in Colorado Springs cause widespread impacts. The greatest threat is to public safety on major roads and highways. Power outages caused by snow, ice, and wind accompanied by cold temperatures, create additional needs for shelter. Other issues caused by winter storms can be related to school closures, business closures, road closures, snow removal, and maintaining critical services like emergency services, food providers, and banks.

Estimating Potential Losses: Winter storms affect the entire planning area, including all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be other costs associated with lost time, maintenance costs, and contents within structures. Estimated costs for individual winter storm events are not readily available from the City of Colorado Springs or the National Oceanic and Atmospheric Administration (NOAA); however, the Colorado State Mitigation Plan mentioned that a storm in 1987 cost the City of Colorado Springs an estimated $575,000.

Secondary Impacts: The Colorado SEOP shows severe winter storms potentially causing a series of secondary impacts including an avalanche, flood (once snows may rapidly melt) and/or subsidence. There is a strong possibility that a severe winter storm can cause transportation issues, with roads blocked, airports out of service, and utility disruptions.

Future Development: New structures built in Colorado Springs should be able to withstand significant snow loads when constructed to City building codes. Development on the fringe may be more susceptible to access issues for emergency services and road crews. Figure 4-52 shows the City's primary and secondary snow routes.

Data Limitations

Weather data is limited by the observations reported; many events are never reported or recorded with the National Weather Service or other archiving agencies.

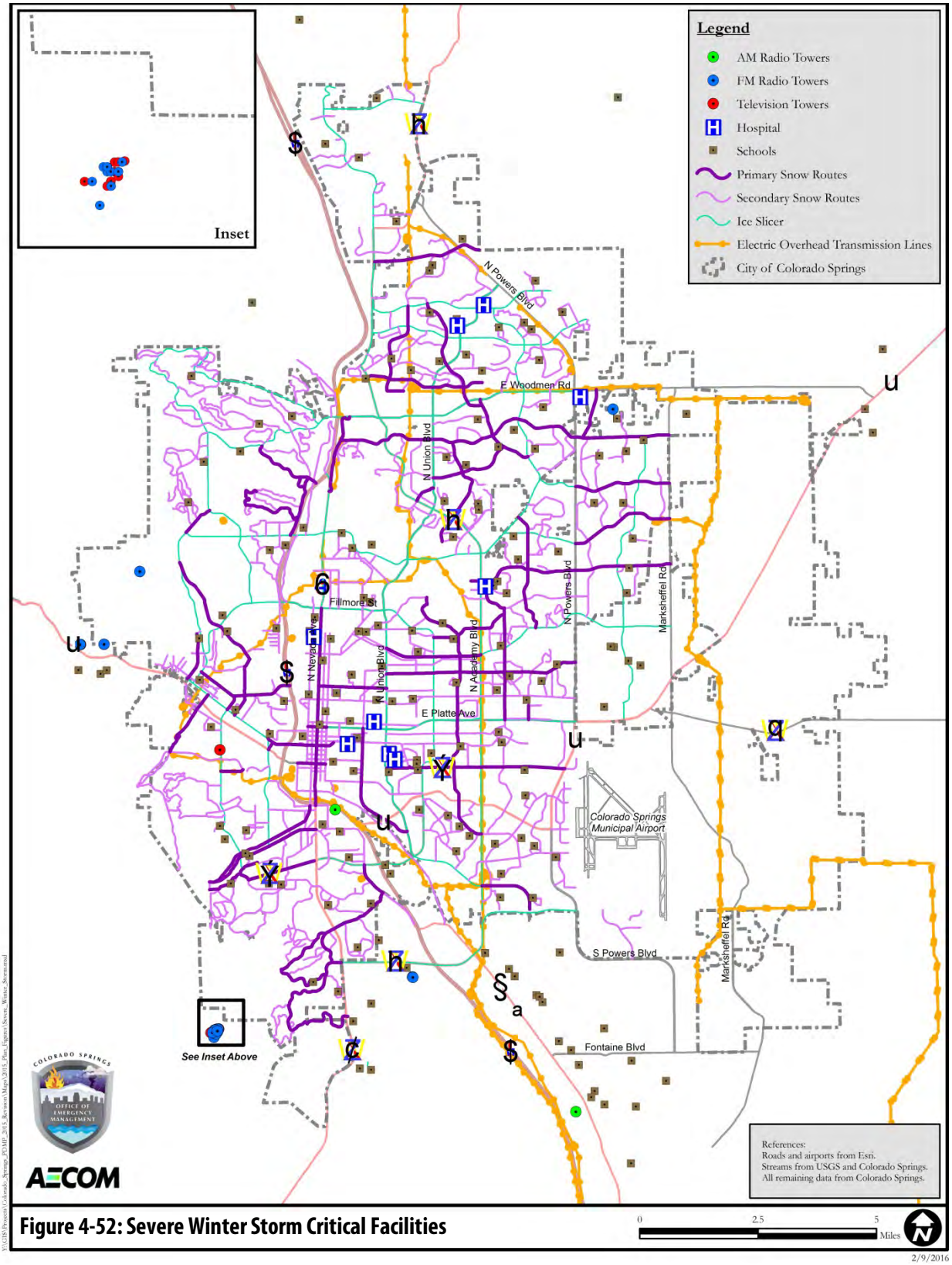


Figure 4-52: Severe Winter Storm Critical Facilities

4.5.6 Drought

Hazard Description

Drought is a shortage of water associated with a deficiency of precipitation due to prolonged climate patterns, and occurs when a normal amount of moisture is unavailable to satisfy an area's usual water consumption. Drought can be defined regionally based on its effects in the following categories:

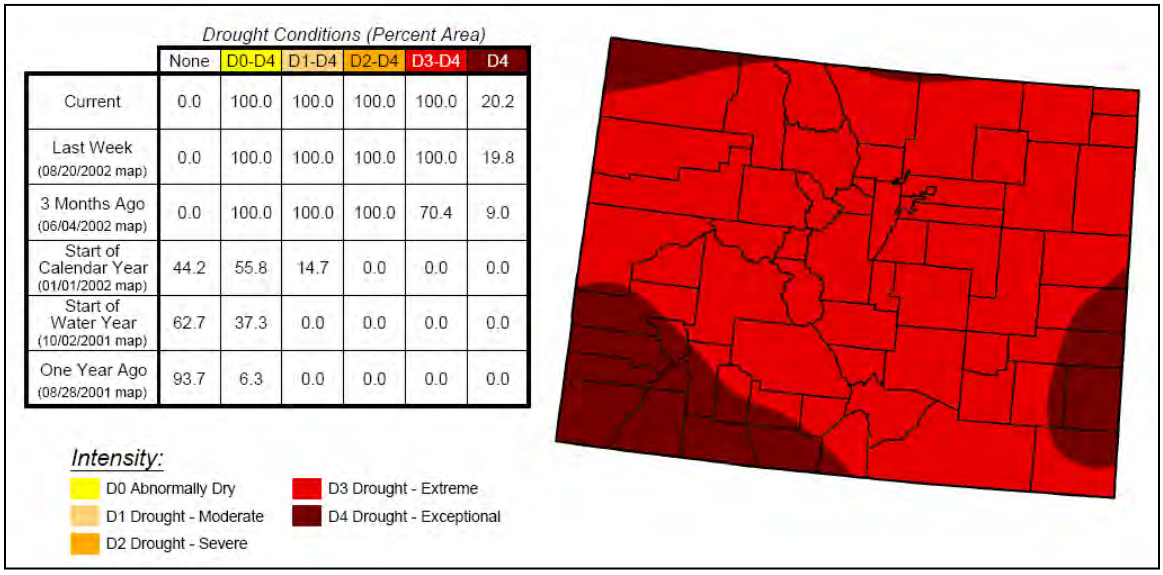
- **Meteorological** drought is usually defined by a period of below average water supply.
- **Agricultural** drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- **Hydrological** drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- **Socioeconomic** drought occurs when a drought impacts health, well-being, and quality of life or when a drought starts to have an adverse economic impact on a region.

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or wildfires, occur relatively rapidly and afford little time to prepare for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Geographic Location

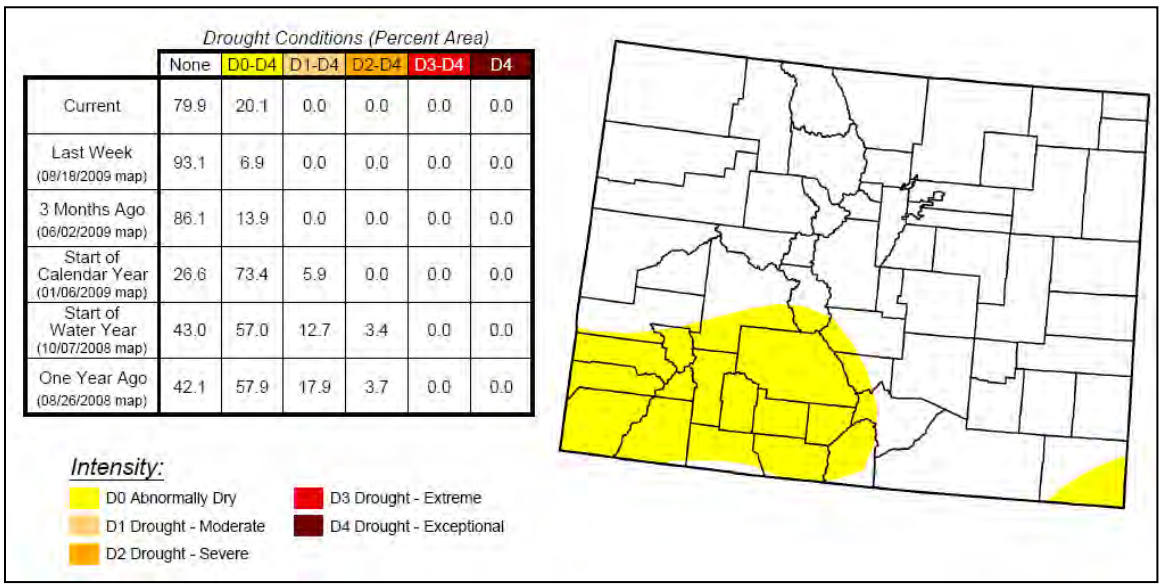
Drought is a regional phenomenon and affects all areas of Colorado Springs with similar frequency and severity. The U.S. Drought Monitor provides online maps of the current drought status nationwide, updated weekly. Below are examples of Colorado drought conditions; one from August 2002 (Figure 4-53), one from August 2009 (Figure 4-54), and current drought conditions from May 2015 (Figure 4-55). In 2002, Colorado saw one of the driest years on record, whereas 2009 was somewhat of a wet year for the region. Current conditions in the state indicate severe drought conditions in the western and southeastern potions of the state. However, the planning area is not experiencing drought conditions at the time of this Plan.

Figure 4-53: Colorado Drought Conditions August 27, 2002 – Extreme Drought



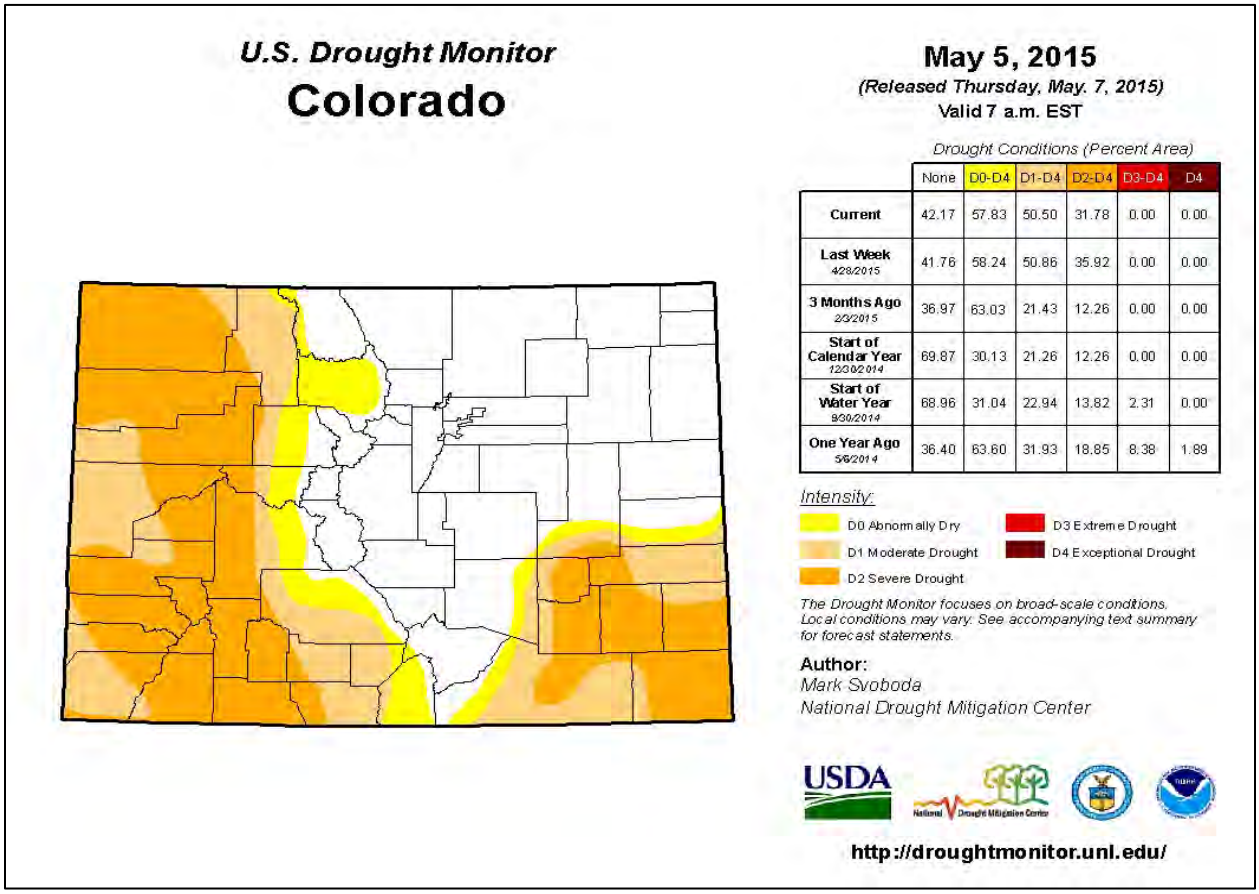
Source: National Drought Mitigation Center's Drought Monitor, http://www.drought.unl.edu/dm/index.html, accessed November 19, 2009. 2016 Plan updated link: http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx.

Figure 4-54: Colorado Drought Conditions August 25, 2009 – No Drought Conditions



Source: National Drought Mitigation Center's Drought Monitor, http://www.drought.unl.edu/dm/index.html, accessed November 19, 2009. 2016 Plan updated link: http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx.

Figure 4-55: Colorado Drought Conditions May 5, 2015 – No Drought Conditions



Source: National Drought Mitigation Center's Drought Monitor, http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?CO, accessed May 13, 2015.

Previous Occurrences

There have been several documented periods of drought throughout Colorado history. The following table outlines known periods of drought in El Paso County.

Table 4-45: Known Drought periods in Colorado Springs (El Paso County, Colorado)

Years	Description of Event	Data Source
1931-1941	Widespread, severe, and long lasting drought in Colorado.	State Drought Plan
1950-1956	Statewide, worse than the 1930s in the Front Range. $40 million in federal aid made available for 13 drought stricken states and used to defer cost of transporting hay.	NDMC
1989	Estimated crop damage nearly $1,000,000.	SHELDUS

Years	Description of Event	Data Source
2000-2003	Significant multi-year statewide drought, with many areas experiencing most severe conditions in Colorado in instrumented history. 2002 was the driest year on record for the Denver region and much of the state. For the first time in state history, the Colorado governor asked the federal government to declare all of Colorado a drought disaster area. Estimated 1.1 billion in losses to Colorado's agricultural, tourism, and recreational industries.	CWCB
2005	El Paso County designated as natural disaster area.	USDA-FSA
2006	El Paso County designated as natural disaster area.	USDA-FSA
2008	El Paso County designated as natural disaster area as a continuous drought occurred throughout the year.	USDA-FSA
2011	El Paso County designated as natural disaster area.	USDA-FSA
2012	El Paso County designated as natural disaster area.	USDA-FSA
2013	El Paso County designated as natural disaster area.	USDA-FSA

Sources: Colorado Water Conservation Board (CWCB) Drought and Water Supply Assessment, 2004, http://cwcb.state.co.us/Conservation/Drought/Drought_Water/index_DWSA.html; National Drought Mitigation Center (NDMC) Drought Impact Reporter, http://droughtreporter.unl.edu/., accessed on December 2, 2009; U.S. Department of Agriculture Farm Services Agency, management/drought/Documents/StateDroughtMitPlan2013/ColoradoDroughtMitigationResponsePlan2013.pdf, accessed May 12, 2015.

Statewide, Colorado has experienced multiple wet and dry cycles. The *Colorado Drought Mitigation and Response Plan (2013)* identified the multi-year dry periods in Colorado, as illustrated in Table 4-46.

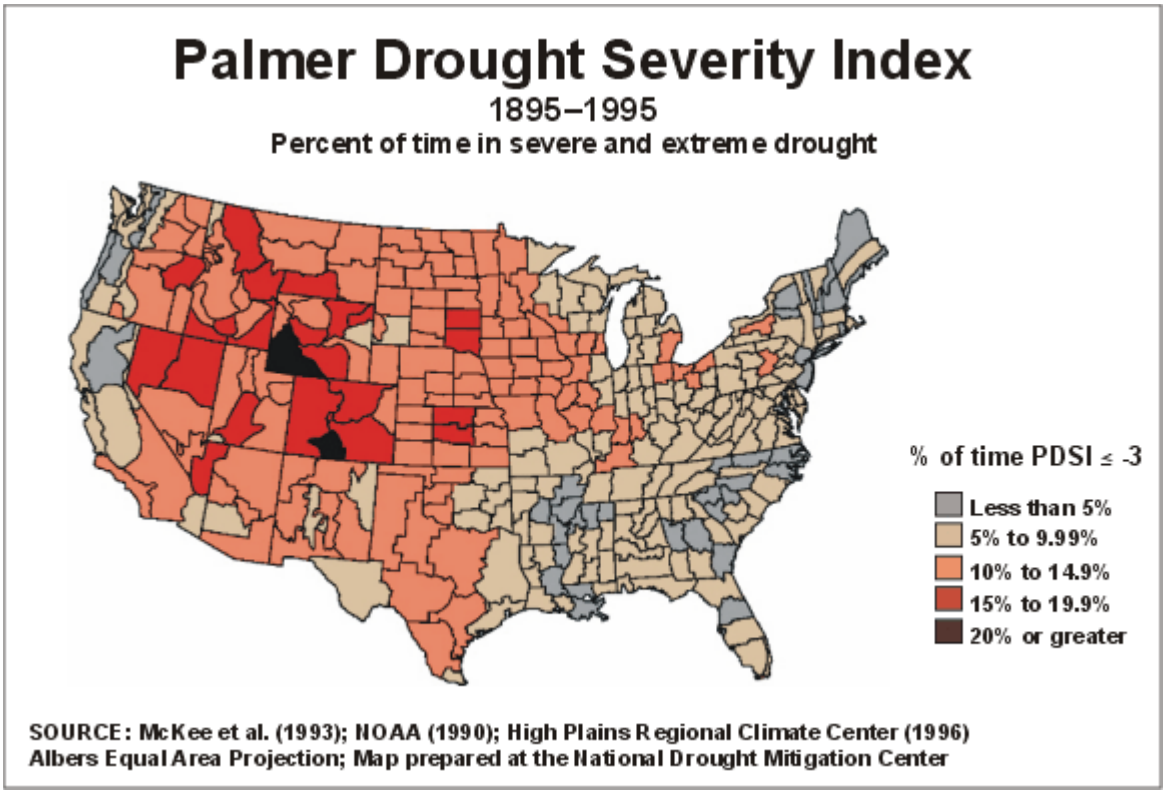
Table 4-46: Colorado Historical Dry Periods

Years	Duration of Event (years)
1893-1905	12
1931-1941	10
1951-1957	6
1963-1965	2
1975-1978	3
2000-2006	6
2010-2012	2

Source: Colorado Drought Mitigation and Response Plan 2013, http://cwcb.state.co.us/water-management/drought/Documents/StateDroughtMitPlan2013/ColoradoDroughtMitigationResponsePlan2013.pdf, Accessed on June 14, 2015.

Figure 4-56 shows that Colorado Springs is located in an area of Colorado that has experienced drought 15-20% of the time over the 100-year period from 1895-1995.

Figure 4-56: United States Percent of Time in Drought, 1895–1995



Source: National Drought Mitigation Center, http://drought.unl.edu/whatis/palmer/pdi1895.gif, accessed on November 10, 2009. Link no longer operable.

In 2005, Colorado Springs had a mandatory watering restriction in effect from April 15 to October 15. This restriction prohibited watering between 9:00 a.m. and 6:00 p.m. and designated specific watering days for customers. Voluntary watering restrictions went into effect from October 2005 through 2009.[30] These restrictions indicated a response to dry periods where scarcity of water called for immediate action.

Due to a below average snowfall in the winter of 2012-2013, the City Council approved moving to Stage II of the Water Shortage Ordinance which includes mandatory watering restrictions that started on April 1, 2013. Outdoor landscape watering was only allowed two days a week on designated days and for up to three hours on the designated days. Residents and businesses that exceed water use over a certain amount received penalties. The goal for community water savings was 30% (5.8 billion gallons of water) and the City was able to reach this goal.[31]

At the time this section of the Plan was prepared (June 2015), the Colorado Springs Water Shortage Ordinance was set at Stage 1, a watch. While this is a voluntary restriction, it is in recognition that water is a scarce resource and subject to dynamic changes year to year. Despite a relatively wet spring, some parts of Colorado are still in severe drought.

[30] Email from Tama Wagoner, Colorado Springs Utilities, January 12, 2010.

[31] Colorado Springs Gazette article, http://gazette.com/colorado-springs-utilities-will-forgo-watering-restrictions/article/1519234, Accessed June 29, 2015 and http://coloradosprings.mountainhightree.com/Colorado-Springs-Water-Restrictions.aspx, Access June 29, 2015

Probability of Future Occurrence

Likely: *10-100% chance of occurrence in next year or a recurrence interval of 10 years or less.*

When known previous occurrences are examined, there were 10 known periods of drought affecting El Paso County since 1931, an 84-year period. Based on this we can estimate a probability of 12% that a drought will occur in a given year, or that a drought will occur once every eight years.

Climate Change Impacts

Future climate scenarios suggest that several factors will lead to more frequent and more intense droughts in Colorado. These variables include a warmer and drier climate, less snowpack, lower streamflow amounts, and less surface water availability. These impacts will strain the water resource needs of Colorado Springs and stress people, agriculture, and ecosystems. Increased drought will likely lead to increased risk from wildfire and insect outbreaks.

Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours*

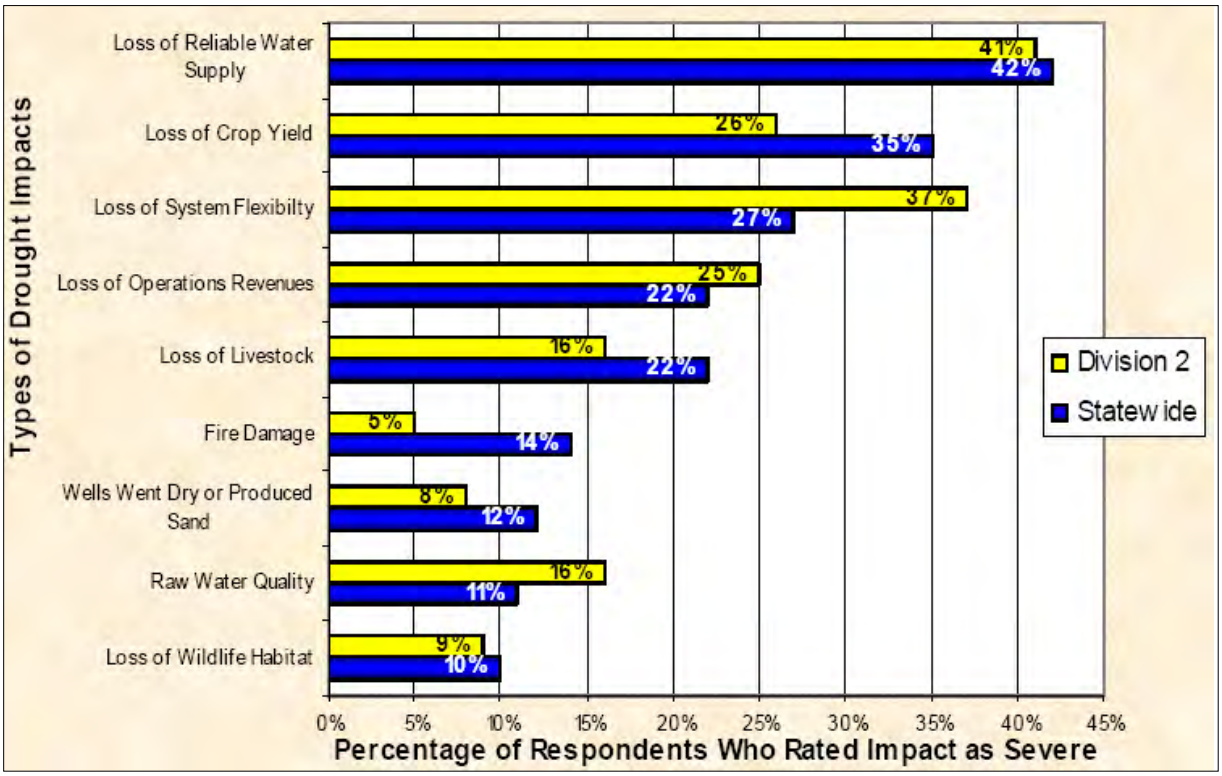
Although no injuries or property damage is typically associated with drought, the loss of farmland and diminishing domestic water supply can be devastating to local economies. Although Colorado Springs has fewer farms than eastern El Paso County, the City would still feel the economic and social impacts associated with drought.

Vulnerability Assessment

Overall Summary and Impacts: The most significant impacts from drought are related to water-intensive activities, such as municipal usage, agriculture (both crops and livestock), wildfire protection, commerce, recreation, and wildlife preservation (through maintained wetlands), as well as a reduction of electric power generation and water quality deterioration. Secondary impacts of drought are wildfires, wind erosion, and soil compaction that can make an area more susceptible to flooding.

In the 2004 Drought and Water Supply Assessment for the Arkansas Basin (Division 2), completed by the CWCB, water users including Colorado Springs, rated the severity of impacts from the 1999-2003 drought. Figure 4-57 illustrates the perceived impacts to drought throughout the Arkansas River Basin (Division 2). The results show that water users are most concerned with the loss of a reliable water supply and loss of system flexibility. The Arkansas River Basin users were also significantly more concerned with raw water quality than statewide users.

Figure 4-57: Perceived Drought Impacts in the Arkansas River Basin, 1999-2003



Source: Colorado Drought and Water Supply Assessment, 2004: http://cwcb.state.co.us/NR/rdonlyres/7D82E161-1DA2-4D02-81A6-0BB1F3E36557/0/Arkansas_DWSA.pdf, accessed on 11/19/09.

The NDMC identifies impacts of drought by county through its Drought Impact Reporter. This is a collection of disaster declarations, online newspaper articles and scientific publications, and other information pertaining to drought that identifies a particular impact to drought including environmental, social, agricultural, water use/energy, fire, and others. This database includes 120 drought impacts specific to El Paso County since 1950. The most prominent impact listed is agricultural, followed by fire and social. Social impacts are those associated with the public or recreation/tourism, loss of human life from heat stress, loss of aesthetic values, etc.

CSU enacts a Water Shortage Ordinance (Chapter 12 – Utilities; Article 4 – Water Code; Part 13 – Water Shortage, revised and passed by City Council on April 22, 2014) when it anticipates lower than normal water supply. Below are the four stages of water shortage in this ordinance:

- Stage 1 – Watch: Water customers are encouraged to follow the voluntary water conservation measures which are listed in the ordinance.
- Stage 2 – Warning: A series of mandatory restrictions are enacted which are mostly to limit outdoor watering use. Penalties are assessed for uses above allowable amounts.
- Stage 3 – Severe: Includes more restrictive uses of water including some reduction in indoor use.
- Stage 4 – Critical: Is the most restrictive level and mandatory reductions in water usage will be in proportion to the severity of the water shortage.

Identifying Structures and Estimating Potential Losses: Drought normally does not impact structures. Although water and sewer infrastructure may be affected by drought, other critical facilities are generally not. Data is not available to estimate potential losses to structures in identified hazard areas. The greatest risk to people from drought is the drinking water supply through water systems or individual wells. CSU completed their Water Conservation Plan for 2008-2012. That plan indicates there is an adequate water supply to meet the projected needs until 2046, according to future demand expectations.

Concerning damage to crops, the Environmental Working Group (EWG) Farm Subsidy Database retains a national database on disaster payments paid for losses to crops. Table 4-47 shows the payments paid to farms in El Paso County from 2003 to 2013 for disaster losses.

Table 4-47: Crop Disaster Payments Paid in El Paso County, 2003-2013 (Years Available)

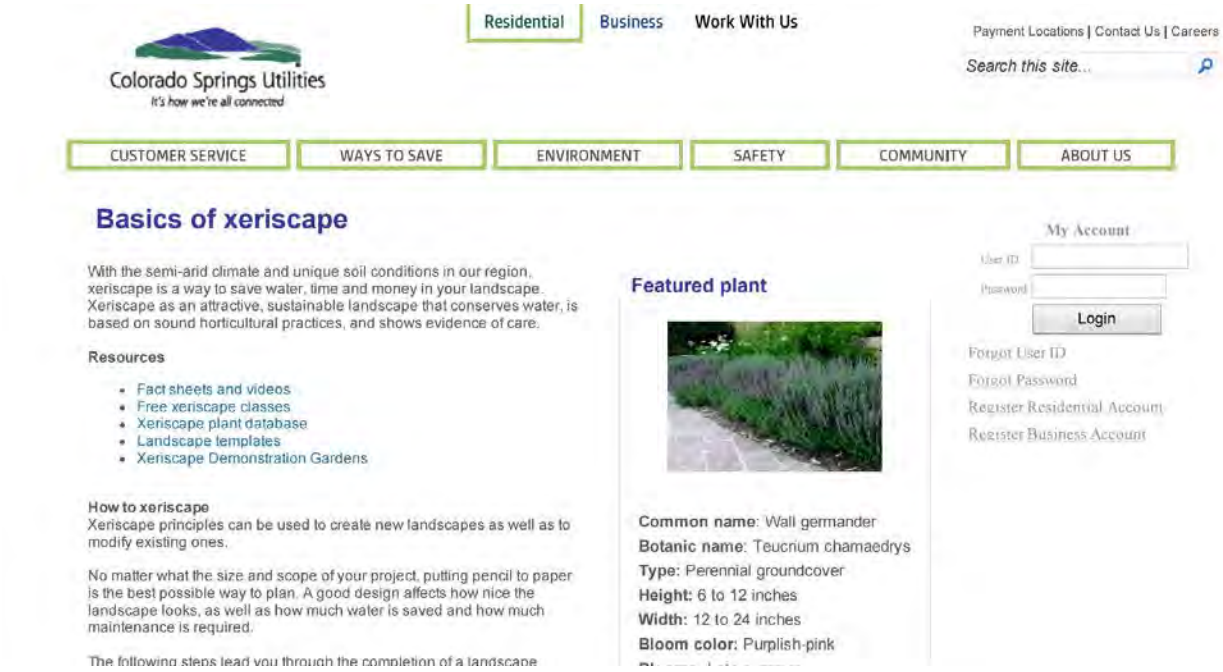
Year	Number of Recipients	Total Payments ($)
2003	68	$759,741
2004	88	$401,085
2005	51	$379,626
2006	29	$86,302
2007	14	$45,596
2008	60	$277,432
2009	32	$280,798
2010	12	$122,459
2011	43	$542,390
2012	22	$227,139

Source: EWG Farm Subsidies, http://farm.ewg.org/region.php?fips=08041&progcode=total&yr=2012, Accessed on September 28, 2015.

Secondary Impacts: An occurrence of drought can also trigger one or more secondary events, particularly wildfire and potentially subsidence as shown in Table 2 of the Colorado SEOP. Severe wildfires are especially a concern during times of severe to exceptional drought.

Future Development: One of the most significant impacts of drought is the decreased supply of water for the city's inhabitants. As growth continues, so does the vulnerability for residents and business owners to drought impacts. Careful monitoring of the city's water supply will help drive conservation efforts and potential land use regulations aimed at minimizing drought impacts among other growth-related impacts. CSU has developed numerous programs aimed at conservation of water. The Xeriscape Education program on the CSU website is one example of how it helps with public outreach regarding water conservation efforts. Figure 4-58 is a screen-capture of the online Xeriscape Education program through CSU.

Figure 4-58: Xeriscape Education from the Colorado Springs Utilities Website



Source: Colorado Springs Utilities website, https://www.csu.org/Pages/xeriscapebasics.aspx, accessed on June 14, 2015.

Data Limitations

Most data on drought is available for the state or the Arkansas Basin, and not city-specific. In addition, total event-specific losses are difficult to assess due to the inability to determine the exact beginning and ending of a drought period.

4.6 Wildfire

Hazard Description

Fire conditions arise from a combination of hot weather, an accumulation of vegetation, and low moisture content in air and fuel. These conditions, especially when combined with high winds and years of drought, increase the potential for wildfire to occur. There are three major factors that sustain wildfires and predict a given area's potential to burn. These factors are fuel, topography, and weather.

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree needles and leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Manmade structures, such as homes and associated combustibles, are also considered a fuel source. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for the spread of fire. In addition, "ladder fuels" can spread a ground fire up through brush into trees, leading to a devastating crown fire that burns in the upper canopy and cannot be controlled.

Topography, or an area's terrain and land slopes, affects its susceptibility to wildfire spread. Due to the tendency of heat from a fire to rise via convection, both fire intensity and rate of spread increases as slope increases. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.

Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out the fuels that feed the wildfire creating a situation where fuel will more readily ignite and burn more intensely. Wind is the most treacherous weather factor. The greater the wind, the faster a fire will spread and the more intense it will be. In addition to wind speed, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. Lightning also ignites wildfires; often in terrain that is difficult for firefighters to reach. Drought conditions contribute to concerns about wildfire vulnerability. During periods of drought, the threat of wildfire increases. Human-caused fires result from activities such as campfires, smoking, equipment use and arson.

Geographic Location

The City of Colorado Springs CWPP was completed in 2011; it will be updated in 2016. The CWPP defines the wildland urban interface (WUI) as the part of the City where people and development meets wildland fuels and topography. The 2011 CWPP identifies 28,800 acres of WUI within Colorado Springs that includes 35,360 individual at-risk parcels. This equates to 23.8% of the total parcels within the City of Colorado Springs and 24% of the population. Most of these WUI areas are in the foothills west of I-25; however, there are additional wildland characteristics on the mesas and bluffs to the east. Bordering the WUI to the west is the Pike National Forest. Within City boundaries are state and county parks. Figure 4-59 illustrates the structures within the WUI in Colorado Springs.

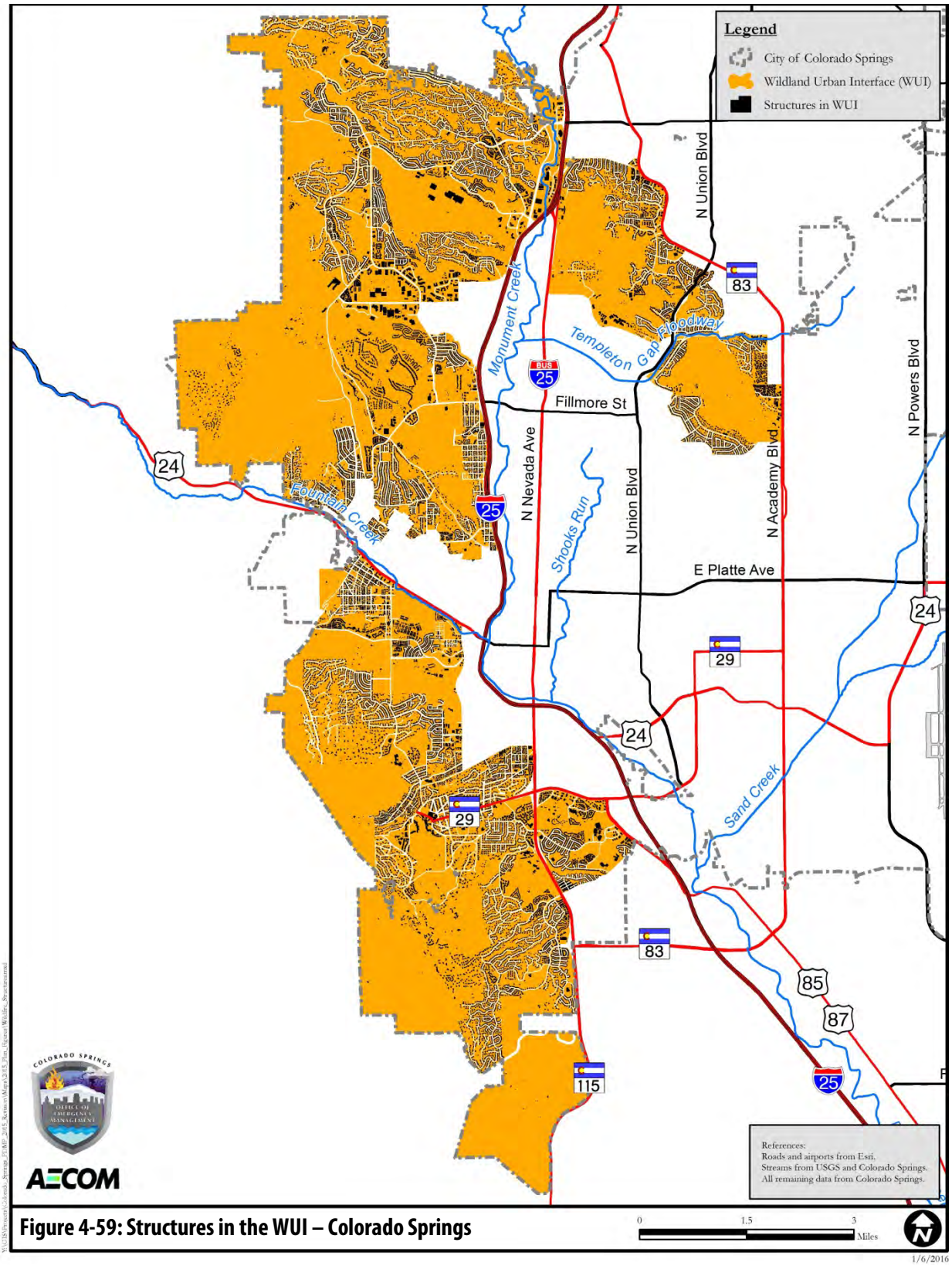


Figure 4-59: Structures in the WUI – Colorado Springs

Previous Occurrences

Colorado experiences many wildfires on an annual basis. With its steep terrain, dense forests, and dry climate, it is expected that wildfires will always be part of Colorado's natural processes. In 2002, in the peak of one of the worst droughts in Colorado history, there were 3,067 recorded wildfires in the state, burning over 925,000 acres. In 2009, as of October 4, there were just over 1,000 fires burning a total of nearly 41,000 acres.[32]

Colorado Springs has also experienced its share of wildfires, dating as far back as 1854. In 1950, an unusual January wildfire burned a large span of land on Cheyenne Mountain. Two of the largest wildfires in Colorado Springs history struck in consecutive years with the Waldo Canyon Fire in 2012 and the Black Forest Fire in 2013. The Waldo Canyon Fire started in U.S. Forestland west of the city whereas the Black Forest Fire hit north of the City mostly in privately owned land.

Waldo Canyon fire. Source: www.nasa.gov

The Waldo Canyon fire is briefly described in Table 4-49 and due to its magnitude, more detailed information is provided in the following paragraphs. Of the 18,247 acres that burned within El Paso County, 14,422 acres were on National Forest System lands (Pike and San Isabel National Forests), 147 acres on Department of Defense land, and 3,678 acres on non-forest lands. The Colorado Springs Together team, a community-driven volunteer effort formed in the aftermath of the fire, reported that 347 homes were lost in the Waldo Canyon Fire. As of June 2015 in the recovery period, 288 permits to build new homes were issued and 268 new homes were completed.[33] The Colorado Springs Together team helped in the recovery by providing the following types of services:

- Insurance assistance and support including facilitating flood insurance sign-up
- Coordinating debris removal
- Conducting flood assessment and sandbagging
- Identifying accredited contractors
- Facilitating educational events

The state's 2015 CDBG Amended Plan reports that 346 housing units were destroyed and that 6,648 insurance claims were made for both real and personal property. The total insurance claim amounts were $453,700,000.[34]

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[32] The National Interagency Fire Center, National Year-to-Date Report on Fires and Acres Burned, http://www.nifc.gov/fire_info/ytd_state.htm, accessed on December 4, 2009.

[33] Colorado Springs Together website at http://www.coloradospringstogether.org/home/index.cfm, accessed on July 5, 2015

[34] Colorado Action Plan Amendment #2 Substantial Amendment for the Third Allocation of CDBG-Disaster Recovery at https://dola.colorado.gov/cdbg-dr/sites/dola.colorado.gov.cdbg-dr/files/cdbg-dr_docs/Colorado%20Substantial%20Amendment%202%203%2031%2015%20To%20Post%20v2%20CC%20Final%20v2%20(1)%20MAU%20IRH.pdf, Accessed on August 6, 2015

The maps on the following pages provide important information about the fire progression, soil burn severity and location of damaged homes. After the fire, members of the Waldo Canyon Regional Recovery Group (the City of Colorado Springs, El Paso County, Manitou Springs, the Colorado Department of Transportation (CDOT), and the USFS) constructed sediment catch basins to slow down any subsequent runoff from storms and laid down dead trees perpendicular to the slope. The City of Colorado Springs followed up with mitigation efforts of their own which are discussed in Section 6.4.

Waldo Canyon burn scar with trees laid down to slow down runoff in Queens Canyon. Source: City of Colorado Springs.

After the Waldo Canyon Fire, the CSFD investigated the reasons for ignition of the structures which resulted in the findings shown in Table 4-48.

Table 4-48: Percentage of Burned Structures by Ignition Source

Ignition Source	Percentage of Burned Structures*
Fire Brands/Embers	54%
Vegetation Exposure	22%
Structural Exposure	16%
Fire Front/Direct Flame Contact	8%

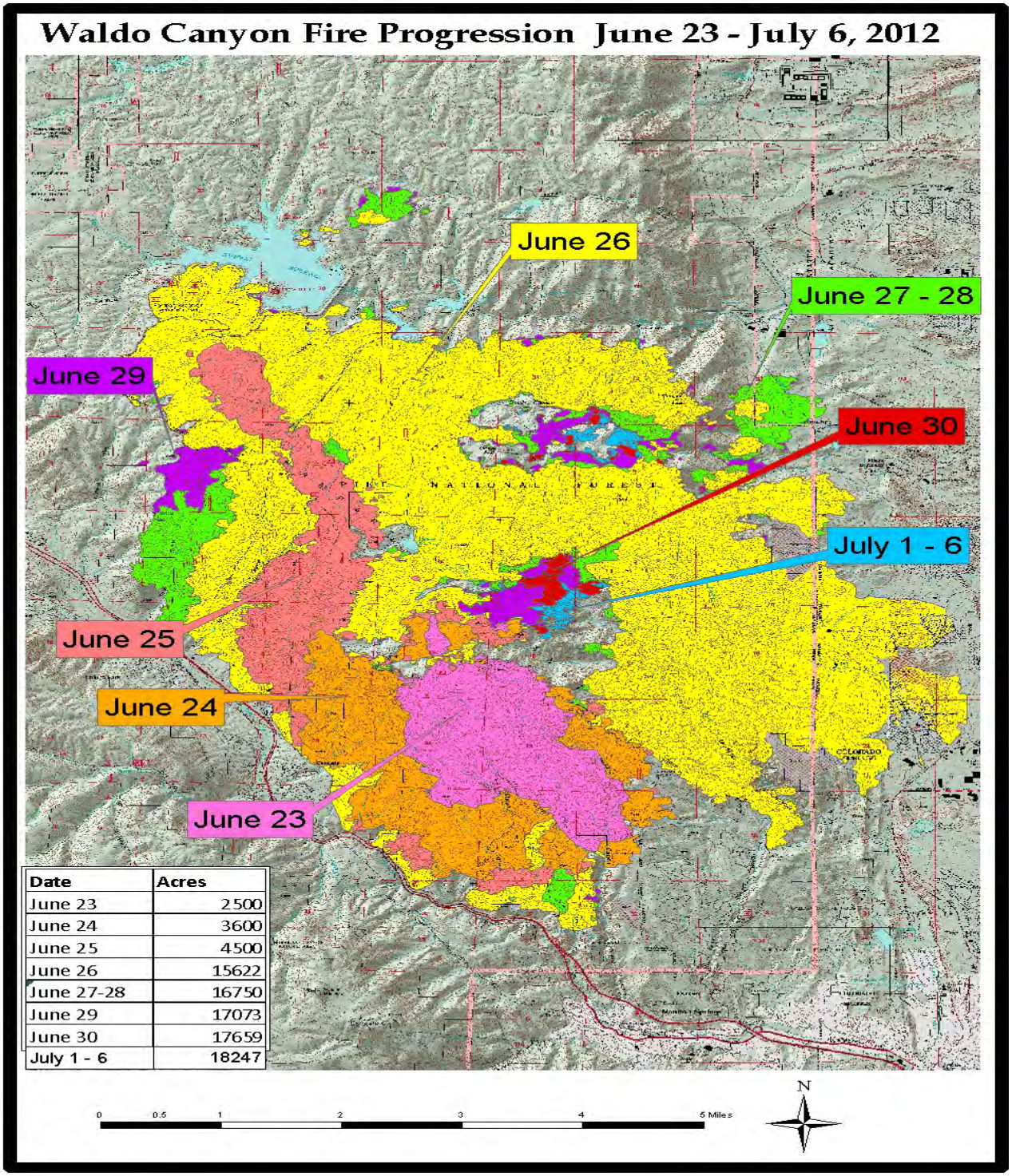
Source: CSFD Ignition Resistant Construction Design Manual 2014

*The percentages reported in this table are estimated based upon investigation findings. This table does not include home counts from the Parkside Neighborhood, Courtney Drive, or Yankton Place. The homes lost in these two neighborhoods were the result of primary ignition of homes from brands/embers, which led to conflagration of the entire neighborhoods through vegetation and structure exposure.

These investigations led to revisions in the Hillside Overlay Ordinance including changes to acceptable types of roofing materials and the requirement for 30 feet of defensible space. Figure 4-60 to Figure 4-62 provide additional Waldo Canyon fire data.

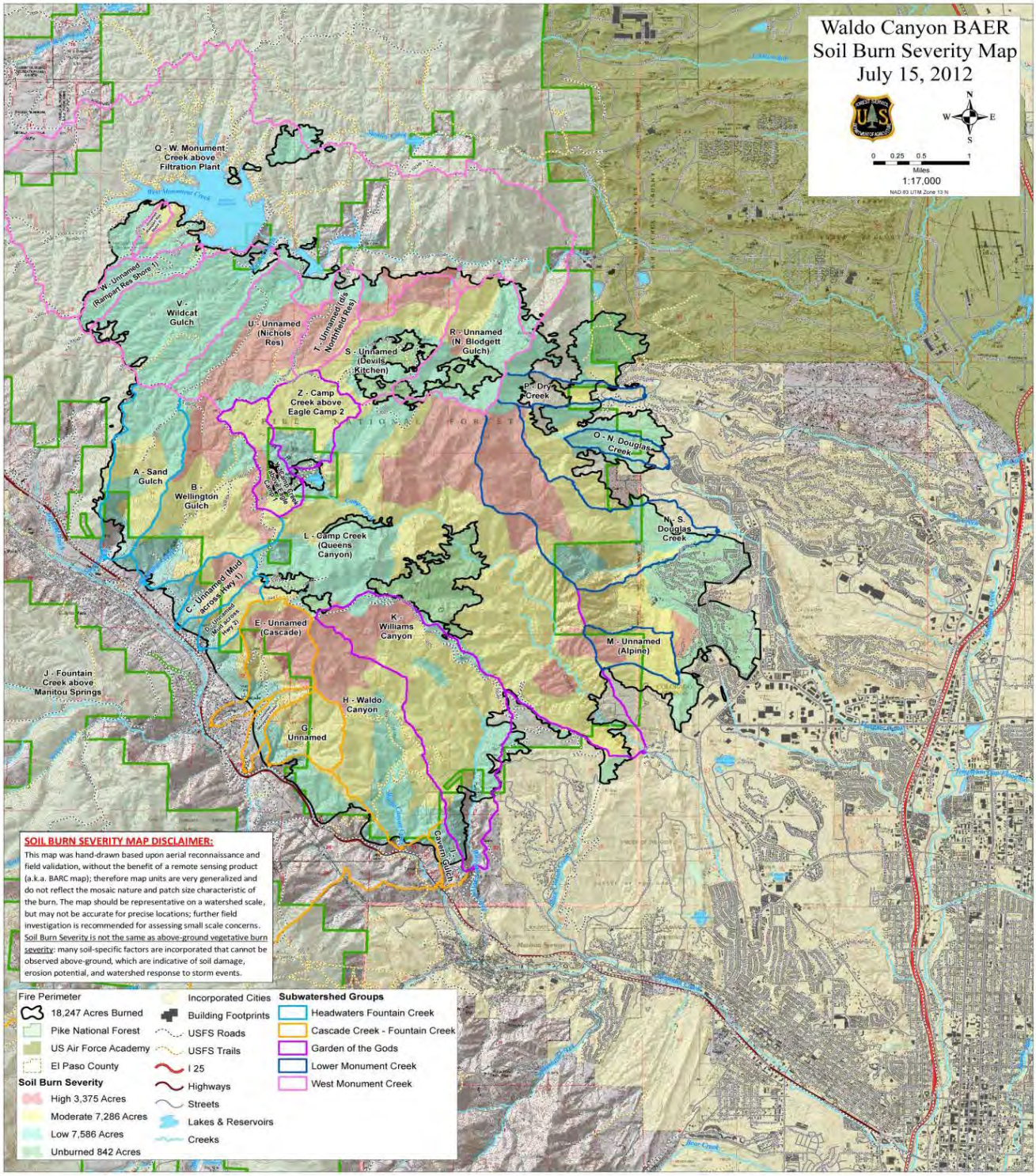
Left: Waldo Canyon fire damaging and destorying homes. Right: Blodgett Peak Open Space post-fire. Source: City of Colorado Springs.

Figure 4-60: Waldo Canyon Fire Progression Map



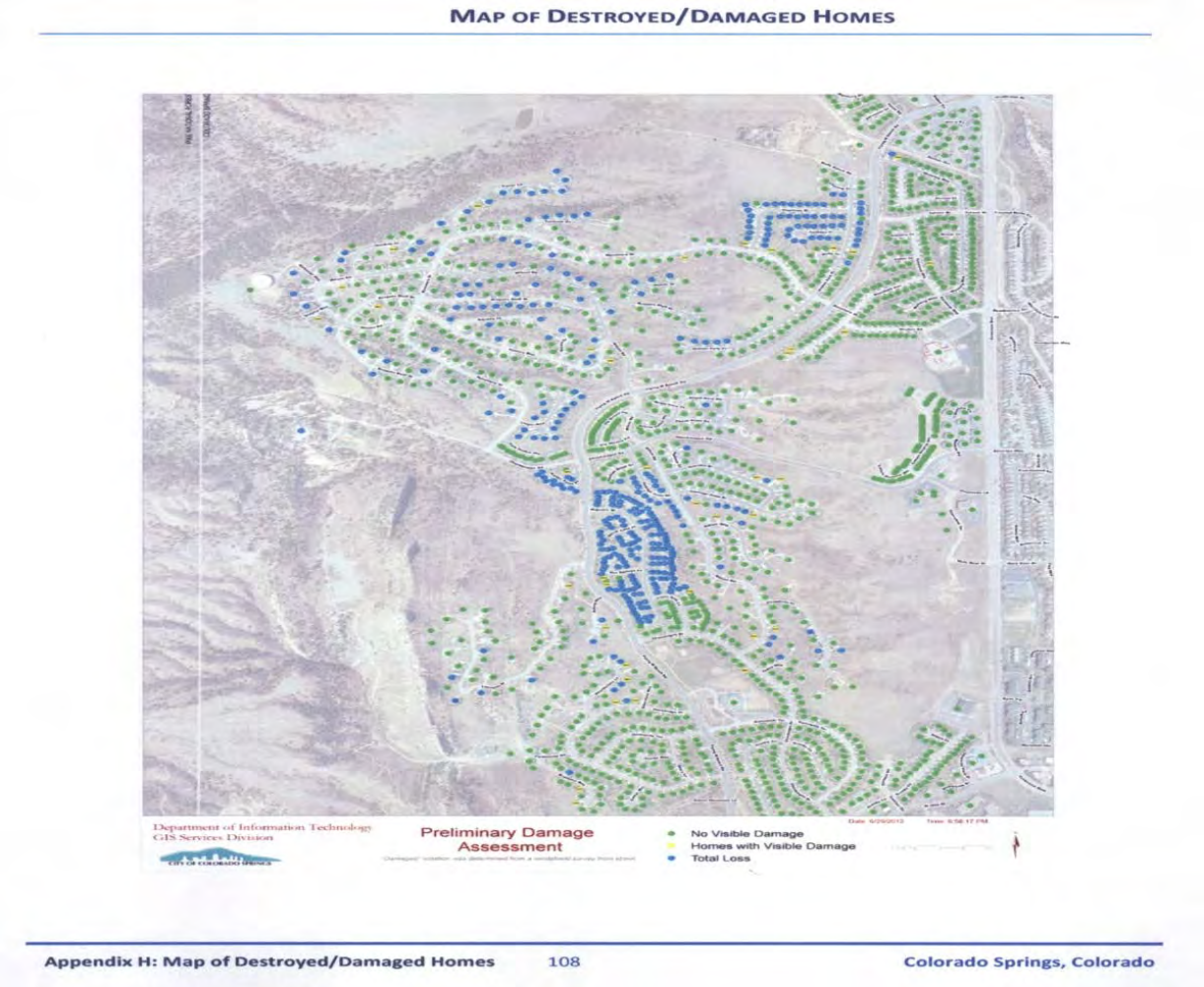
Source: National Wildfire Coordinating Group Incident Information System (InciWeb). Image search June 2015.

Figure 4-61: Waldo Canyon Soil Burn Severity Map



Source: National Wildfire Coordinating Group Incident Information System (InciWeb). Image search June 2015.

Figure 4-62: Waldo Canyon Fire Map of Destroyed/Damage Homes



Source: Colorado Springs Department of Information Technology, Accessed July 2015

For the impacts of flooding after fire, see Section 4.3.1.

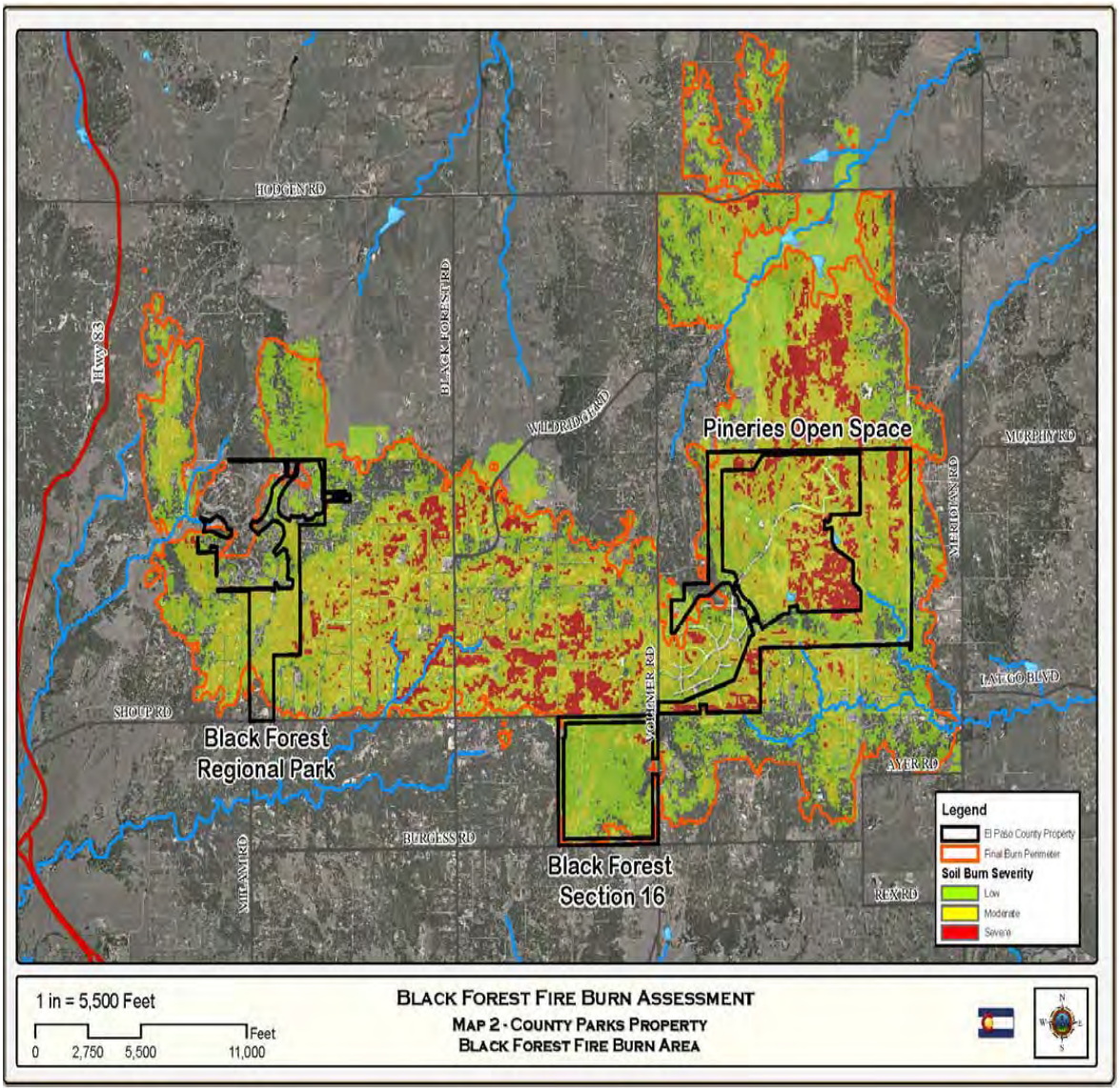
Black Forest Fire

The Black Forest area of El Paso County is a census-designated place northeast of and adjacent to the City of Colorado Springs. It is located along the Palmer Divide and is an area with rolling terrain that is covered by dense forests primarily of ponderosa pine. Other characteristics include wetlands and other unique vegetation groupings. The Black Forest Fire, which ignited on June 11, 2013, grew to over 14,000 acres and profoundly affected the area's residents and ecosystem.

Black Forest Fire. Source: U.S. Air Force

The Colorado Springs Together website reported that 488 homes were lost from the Black Forest Fire. As of June 2015 in the recovery period, 238 permits to build new homes were issued and 115 new homes were completed.[35] The state's 2015 CDBG Amended Plan reports that 489 housing units were destroyed and that there were 4,173 insurance claims made for both real and personal property. The total insurance claim amounts were $420,500,000.[36]

Figure 4-63: El Paso County Black Forest Fire Burn Assessment



[35] Colorado Springs Together website at http://www.coloradospringstogether.org/home/index.cfm, accessed on July 5, 2015

[36] Colorado Action Plan Amendment #2 Substantial Amendment For the Third Allocation of CDBG-Disaster Recovery at https://dola.colorado.gov/cdbg-dr/sites/dola.colorado.gov.cdbg-dr/files/cdbg-dr_docs/Colorado%20Substantial%20Amendment%202%203%2031%2015%20To%20Post%20v2%20CC%20Final%20v2%20(1)%20MAU%20IRH.pdf, accessed on August 6, 2015

Table 4-49: Wildfire History in Colorado Springs and Vicinity

Date	Description	Source*
1854	Big Burn of 1854 burned a swath approximately 70 linear miles from Cheyenne Mountain to Wilkerson Pass.	2005 PDM Plan
1890	Cheyenne Mountain Burn	Draft 2010 CWPP
January1950	Camp Carson/Cheyenne Mountain Fire, claimed the lives of 9 people, including a 14-year old volunteer.	2005 PDM Plan/ Draft 2010 CWPP
4/18/2000	On Fort Carson in southern El Paso county 800 acres of grass was consumed when a power line sparked after being blown down.	NCEI
8/15/2000	A wildfire started by lightning scorched around 2,500 acres of land.	NCEI
4/28/2002	A wildfire, started by sparks from a lawn mower, consumed 64 acres and threatened 7 structures in the Pine Glen subdivision.	NCEI
5/31/2002	4,500 acres burned near Fountain, Colorado.	SHELDUS
June 2002	Hayman Fire in Pike-San Isabel National Forests, burned 68,000 acres in one day alone. Total losses included 137,760 acres and 600 structures. Forced the evacuation of 5,340 persons.	2005 PDM Plan
8/3/2003	A four acre fire near Ute Trail near Waldo Canyon, probably sparked by a lightning strike the day before, was contained by firefighters from six departments and air tankers. Traffic was affected on U.S. highway 24.	NCEI
2005	Westwood Fire burned 35 acres. 1 outbuilding lost.	Christina Randall
2007	Manitou Incline Fire (30 acres)	raft 2010 CWPP
2008	Fort Carson Fire, 1 fatality of Bureau of Land Management pilot fighting the fire.	Christina Randall
4/15/2008	No description available	SHELDUS
5/10/2008	No description available	SHELDUS
8/1/2008	No description available	SHELDUS
2009	Coronado Fire burned 12 acres and threatened Coronado High School and Homes Middle School.	Christina Randall
6/8/2011	The Navajo Fire, northwest of Cripple Creek, consumed around 50 acres. It forced the evacuation of 104 houses and some animals. No structures were damaged or destroyed.	NCEI
6/23/2012	A wildfire erupted in Waldo Canyon, west of Colorado Springs midday June 23 and was not contained until July 10. The fire consumed 18,247 acres, most of which was in National Forest land. Winds gusted to around 65 mph with the fire storm, which consumed 347 structures and took the lives of a husband and wife in one of the houses. At the peak of the event, 32,000 people were evacuated from their houses for a number of days. The President declared El Paso County and Colorado Springs a major disaster area (DR-4067). The Rocky Mountain Insurance Information Association[37] reported $453.7 million in insured losses from the Waldo Canyon fire ($466.7 million in 2014 dollars).	NCEI

[37] From the Rocky Mountain Insurance Information Association found at http://www.rmiia.org/catastrophes_and_statistics/catastrophes.asp, Accessed May 1, 2015

Date	Description	Source*
6/11/2013	The Black Forest wildfire was sparked on the west side of Black Forest and rapidly spread eastward the first day. A couple lost their lives in the blaze the first day. At its height, over 35,000 people were evacuated from the area. The final count of houses completely destroyed was 486, making this wildfire the most destructive in Colorado history. Around 1000 firefighters eventually contained the wildfire, which burned 14,280 acres. The wildfire was likely human-caused. The President declared El Paso County a major disaster area (DR-4134). The Rocky Mountain Insurance Information Association reported $420.5 million in insured losses from the Black Forest fire ($426.3 million in 2014 dollars).	NCEI

* Data from SHELDUS is by county, therefore exact location is unknown. Some records may not be applicable to Colorado Springs specifically.

Figure 4-64: Wildfire on Cheyenne Mountain January 17, 1950

Source: Pikes Peak Library District Special Collections Photo Archives, http://library.ppld.org/SpecialCollections/Project/Search.aspx?JFile=004-5421-di-72.jpg;&view=1, accessed on November 30, 2009.

Table 4-50 records the number of grass/brush fires that CSFD responded to since 1993.

Table 4-50: Grass/Brush Fires CSFD Responded to, 1993-2014

Year	# of Incidents	Year	# of Incidents
1993	288	2004	114
1994	293	2005	156
1995	360	2006	196
1996	416	2007	149
1997	313	2008	220
1998	350	2009	123
1999	248	2010	209
2000	277	2011	205
2001	255	2012	158
2002	232	2013	130
2003	107	2014	126

Source: Data provided by email from Bill Wallace, CSFD on January 4, 2010. Updated by Beth Conklin, CSFD on October 2, 2015.

It is noteworthy that there has generally been a steady decline in the number of grass fires beginning in 2001, when the wildland fire mitigation efforts began. There was a deviation to this trend with increased responses in 2010 and 2011, but this corresponds with a drought in the area. Table 4-51 contains the number of fires (of all types) that were started by lightning.

Table 4-51: Fires ignited by Lightning, Colorado Springs 1993-2009

Year	# of Incidents	Year	# of Incidents
1993	7	2002	14
1994	18	2003	10
1995	8	2004	9
1996	16	2005	11
1997	12	2006	22
1998	12	2007	9
1999	8	2008	9
2000	23	2009	14
2001	17		

Source: Data provided by email from Bill Wallace, CSFD on January 4, 2010. Updated information is not available at the time of the 2016 Plan.

Probability of Future Occurrence

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less*

According to historical data, there were 19 recorded significant wildfires between 1950 and 2014. Therefore, the probability of a wildfire occurring in any given year is 30%. Rephrased, it is expected that a wildfire will occur once every 3.4 years. According

to the grass and brushfire data, it can be expected that at least 100 grass/brushfires will occur in any given year, otherwise expressed as highly likely.

Climate Change Impacts

Generally, future climate scenarios suggest that the climate in Colorado will be warmer and drier with occasional extreme precipitation, heat and cold events. In relation to wildfire risk, there is likely to be greater intensification of drought cycles which correlates to increased wildfire risk. Wildfire risk will likely be exacerbated by outbreaks of pests like the bark beetle that attack trees. In addition, an extremely dry year could be preceded by an extremely wet year where vegetation grew thick and this would result in greater fuel loads the following year. The 2015 Colorado Resiliency Framework states the following about future wildfire risk:

> *The majority of climate projections indicate that wildfires will likely increase in both frequency and severity by the middle of the century. As temperatures increase and snow melts earlier, wildfires will also begin earlier in the season. At the same time, those fires will release CO_2, contributing to the ongoing rise in global temperatures. Research shows that these patterns are manifested in measurable ways, with more large wildfires, significantly more area burned, longer seasons, and longer duration for fire events.*

Magnitude/Severity

Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours.*

Potential losses from wildfire include human life; structures and other improvements; natural and cultural resources; the quality and quantity of the water supply; range and crop lands, and economic losses (tourism, fire expenditures, etc.). Smoke and air pollution from wildfires can be a severe health hazard. Other secondary impacts include future flooding and erosion during heavy rains.

Vulnerability Assessment

Overall Summary and Impacts: Due to many reasons including climate, vegetation, and increasing populations, it is likely that large-scale conflagrations will occur within Colorado and have catastrophic impacts. The City of Colorado Springs is a great leader in mitigation and prevention of wildfires, yet the possibility of a fire that quickly burns out of control is still present for CSFD. The relationship of the natural and built environment defines the risk of wildfires to life and property. Wildfire risk can also be increased by other natural phenomena such as bark beetle outbreaks. These insects generally attack weakened or dying trees which can contribute to a higher fuel load for wildfire.

Identifying Structures and Estimating Potential Losses: Of the 35,360 parcels within the WUI, 28,351 were rated with structures. 24% of the City's population is within the WUI. More than 51% of the total parcels in the WUI are at High, Very High, or Extreme risk to wildfire. Table 4-52 summarizes the aggregate vulnerability.

Table 4-52: Parcel Count by Total Wildfire Risk – Colorado Springs

Risk	Number of Parcels
LOW	818
MODERATE	9,284
HIGH	10,632
VERY HIGH	5,270
EXTREME	2,347
Total	**28,351**

Source: Christina Randall, by email on February 8, 2010. Updated data was not available for the 2016 Plan.

The following Wildfire Risk Ratings maps, Figure 4-65 through Figure 4-76, were taken directly from the draft 2011 City of Colorado Springs "Sharing the Responsibility" CWPP.

Camp Creek Watershed after the Waldo Canyon Fire. Source: City of Colorado Springs

Figure 4-65: Wildfire Risk Ratings – Cheyenne Mountain Vicinity

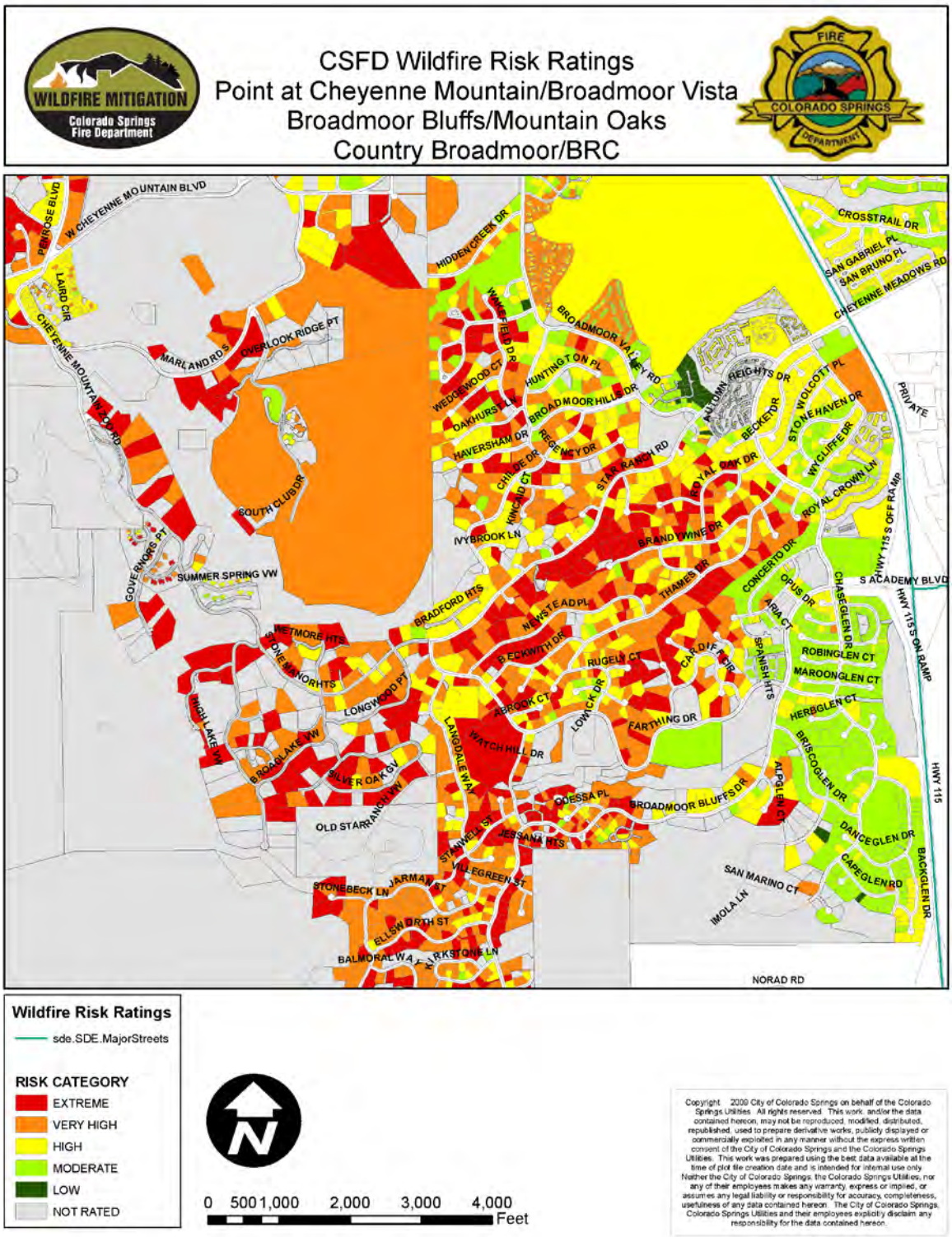


Figure 4-66: Wildfire Risk Ratings – University Park and Vicinity

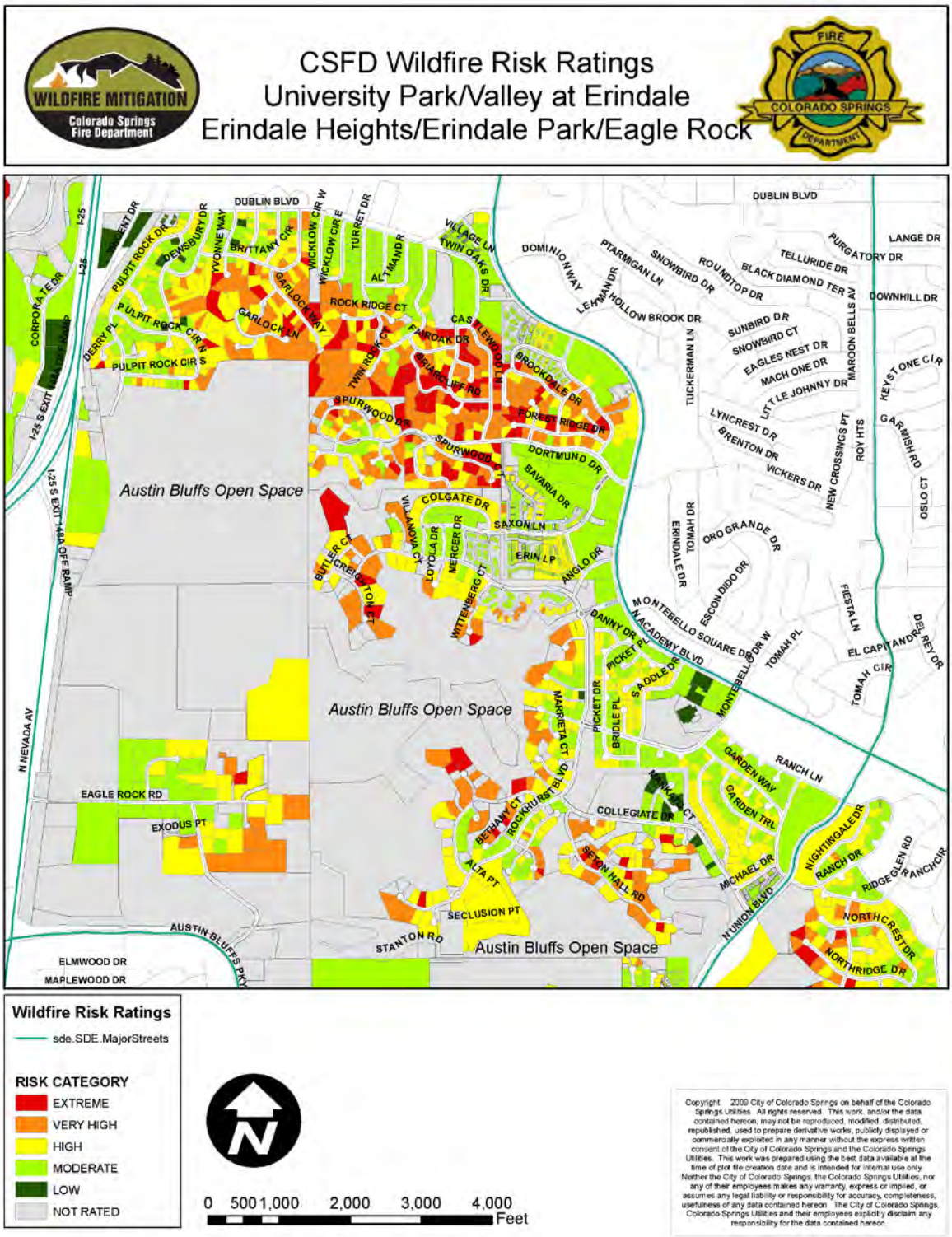


Figure 4-67: Wildfire Risk Ratings – Cedar Heights

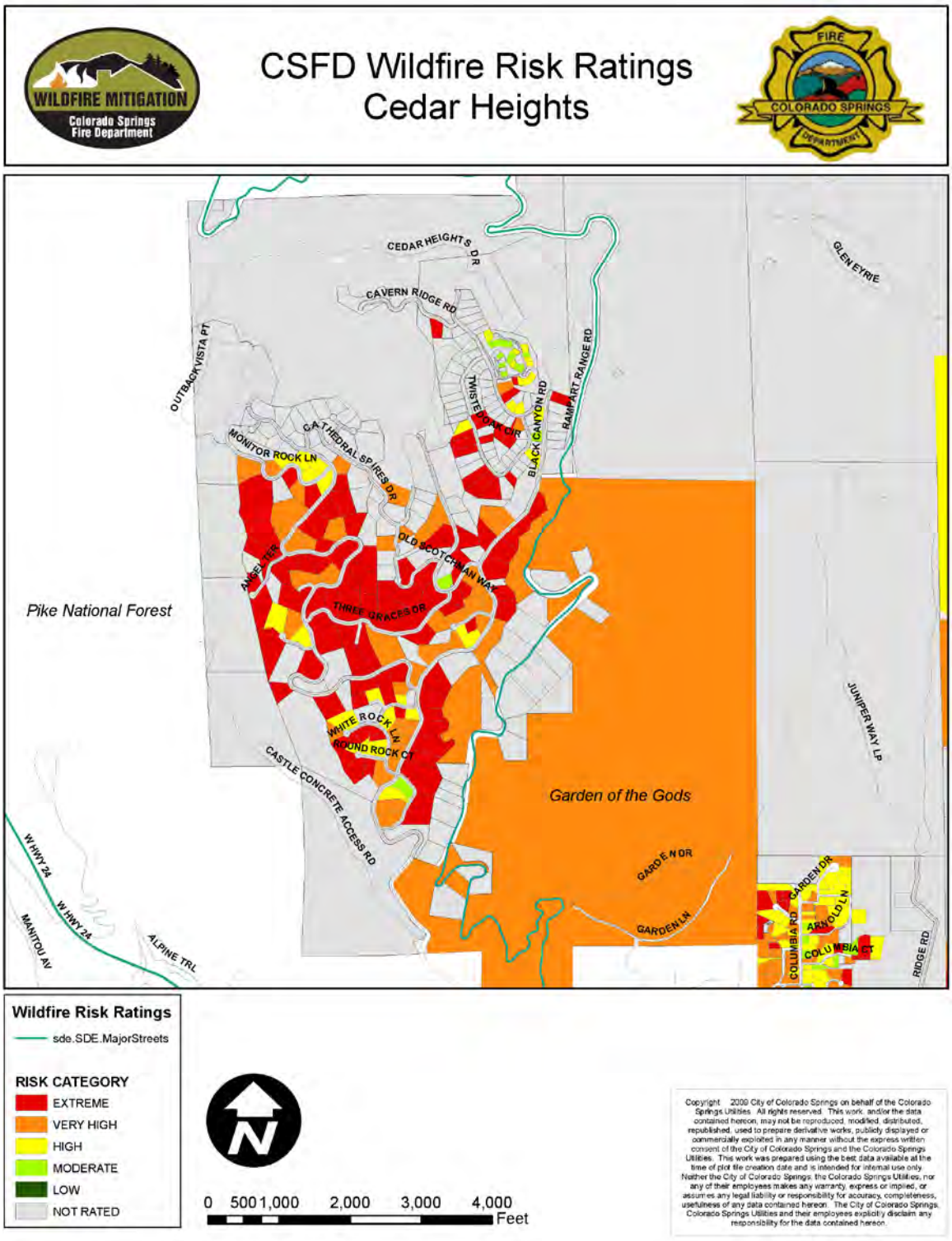


Figure 4-68: Wildfire Risk Ratings – Greencrest/Cragmor Village

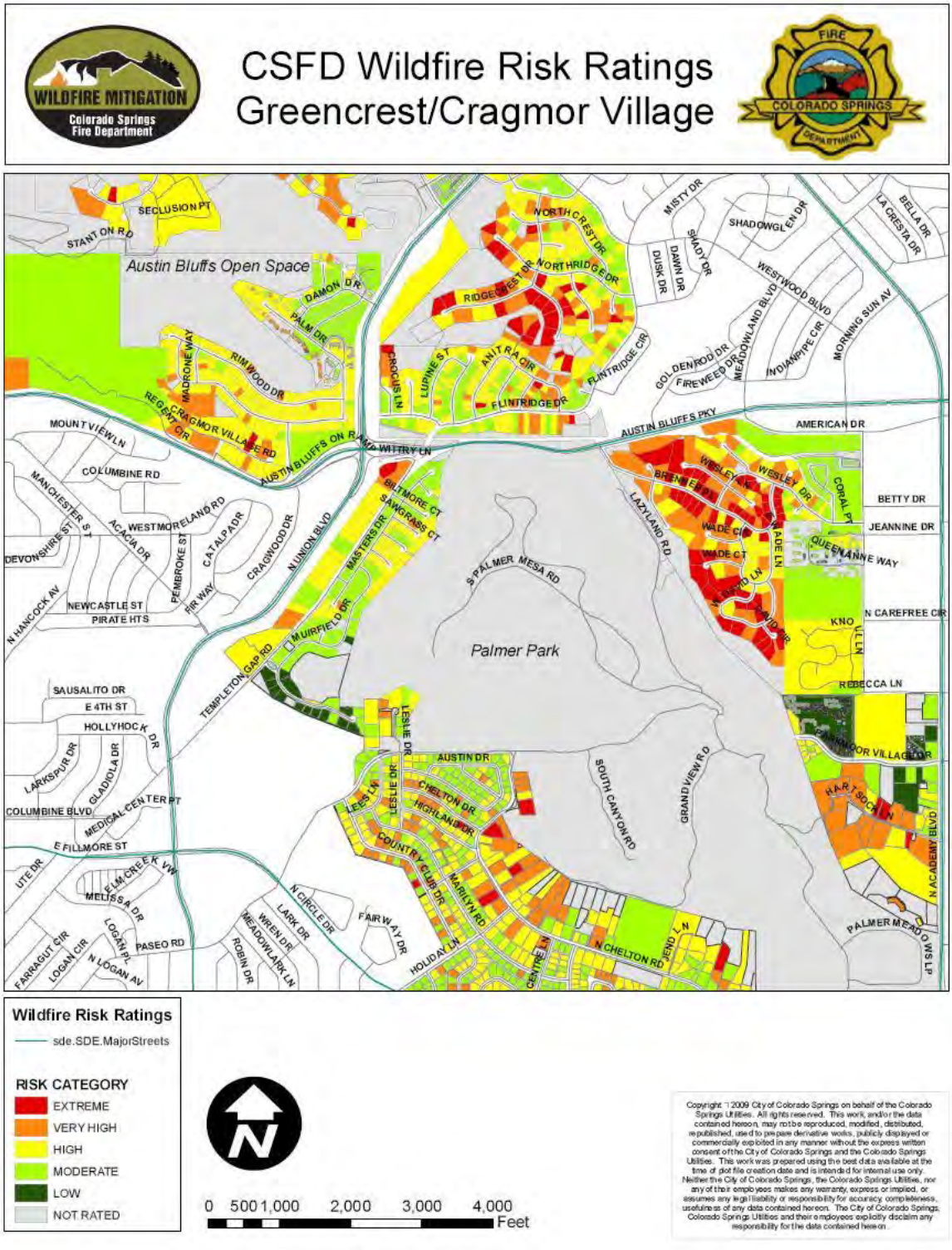


Figure 4-69: Wildfire Risk Ratings – Kissing Camels Park

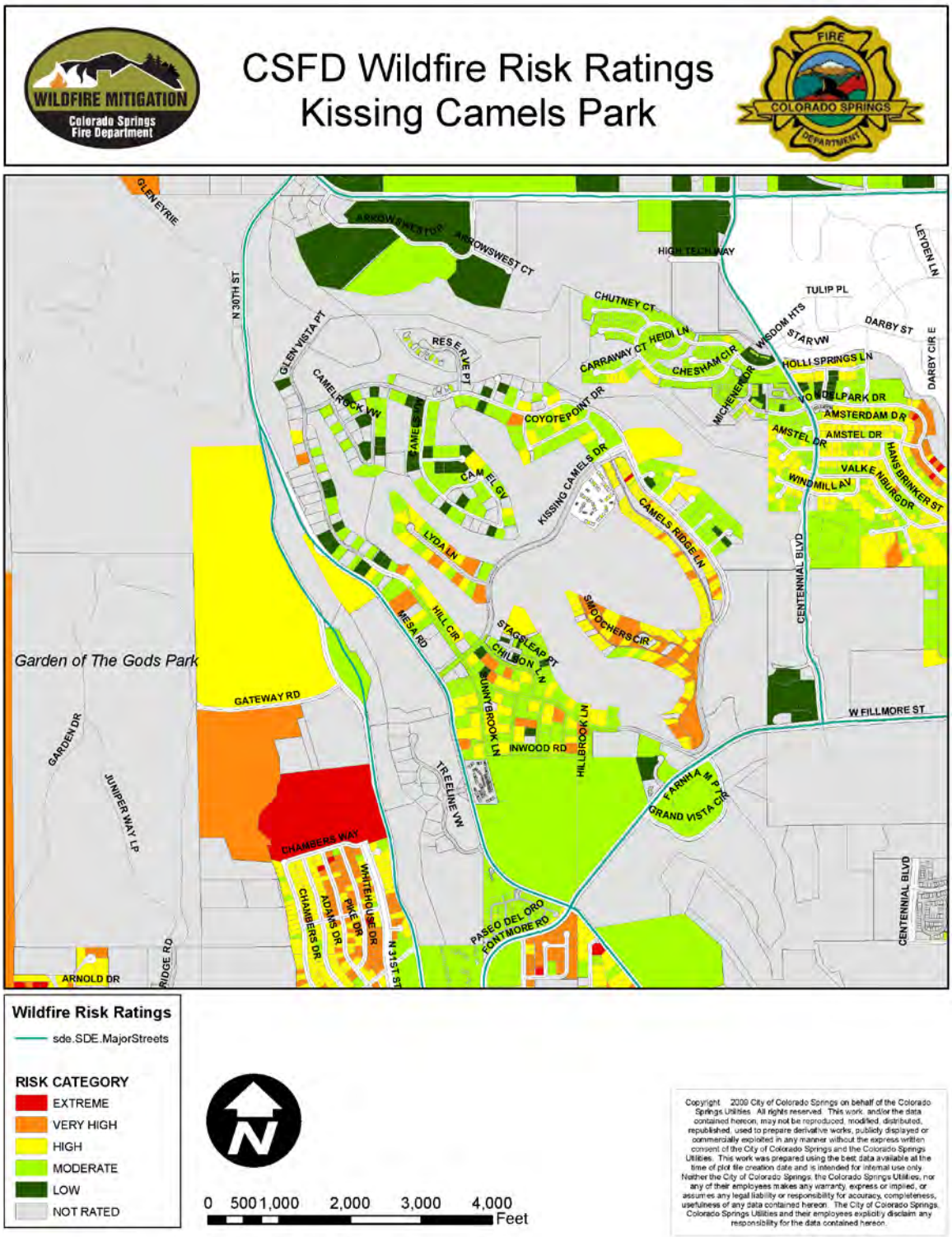


Figure 4-70: Wildfire Risk Ratings – Mountain Shadows

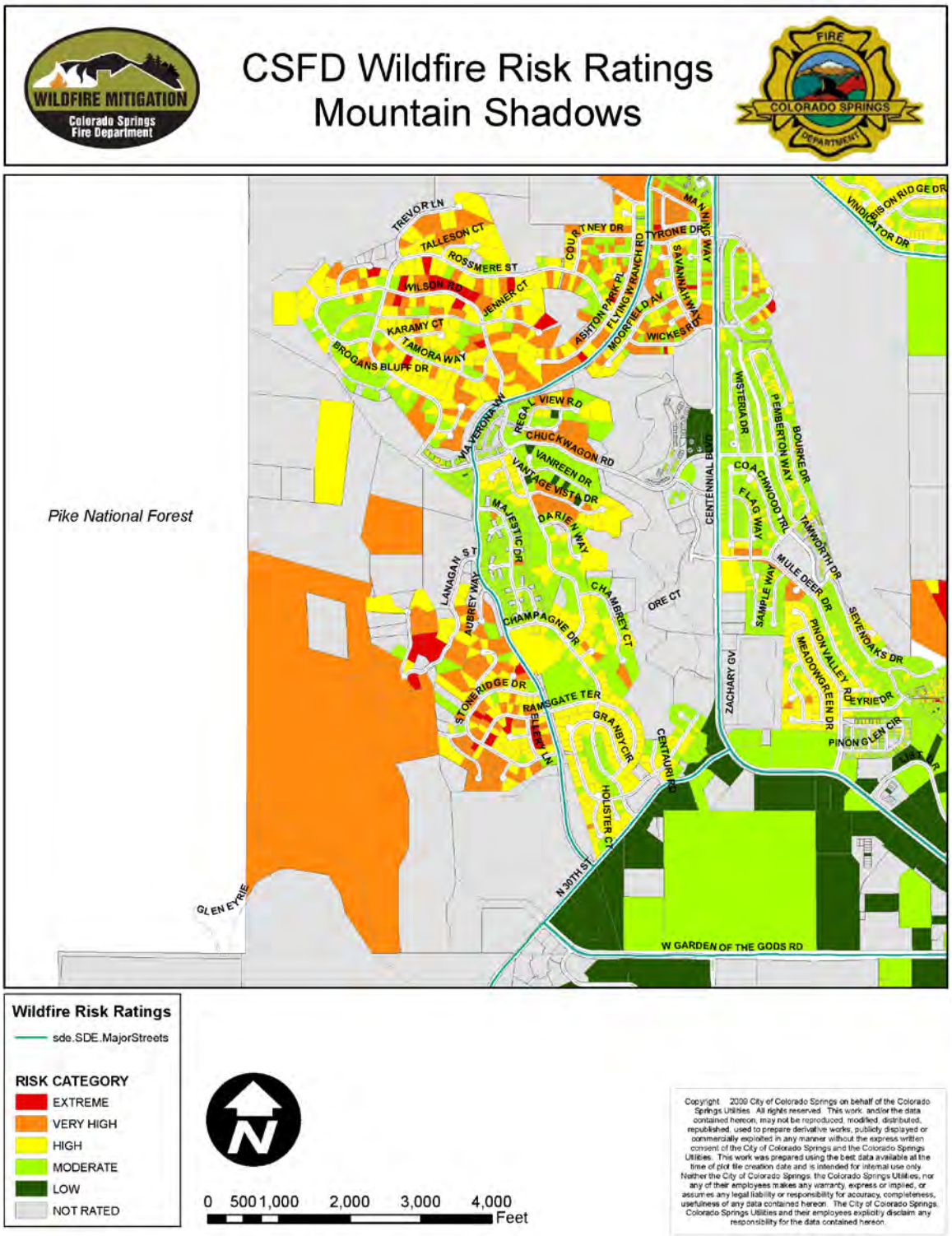


Figure 4-71: Wildfire Risk Ratings – North Cheyenne Cañon

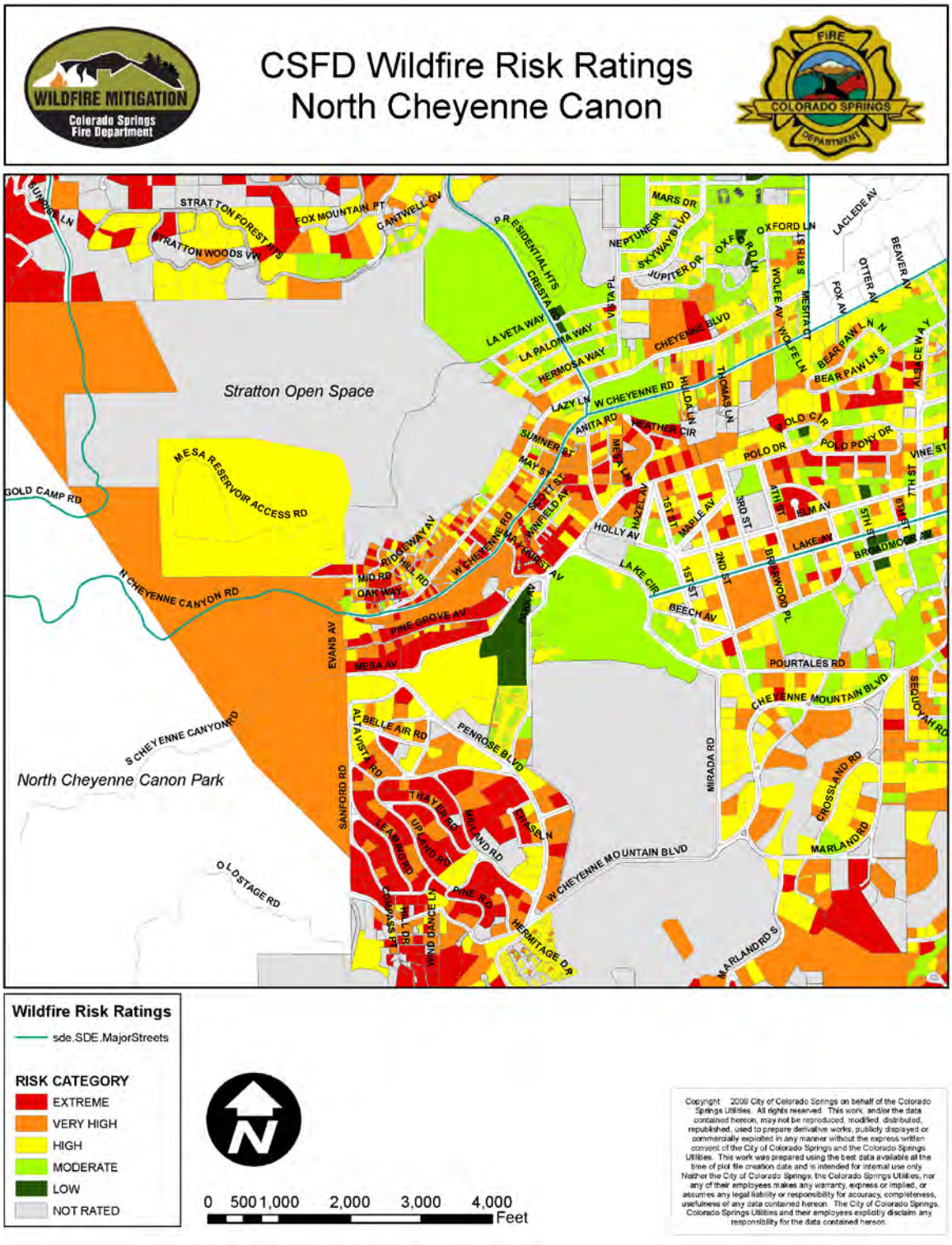


Figure 4-72: Wildfire Risk Ratings – Peregrine/Hunters Point

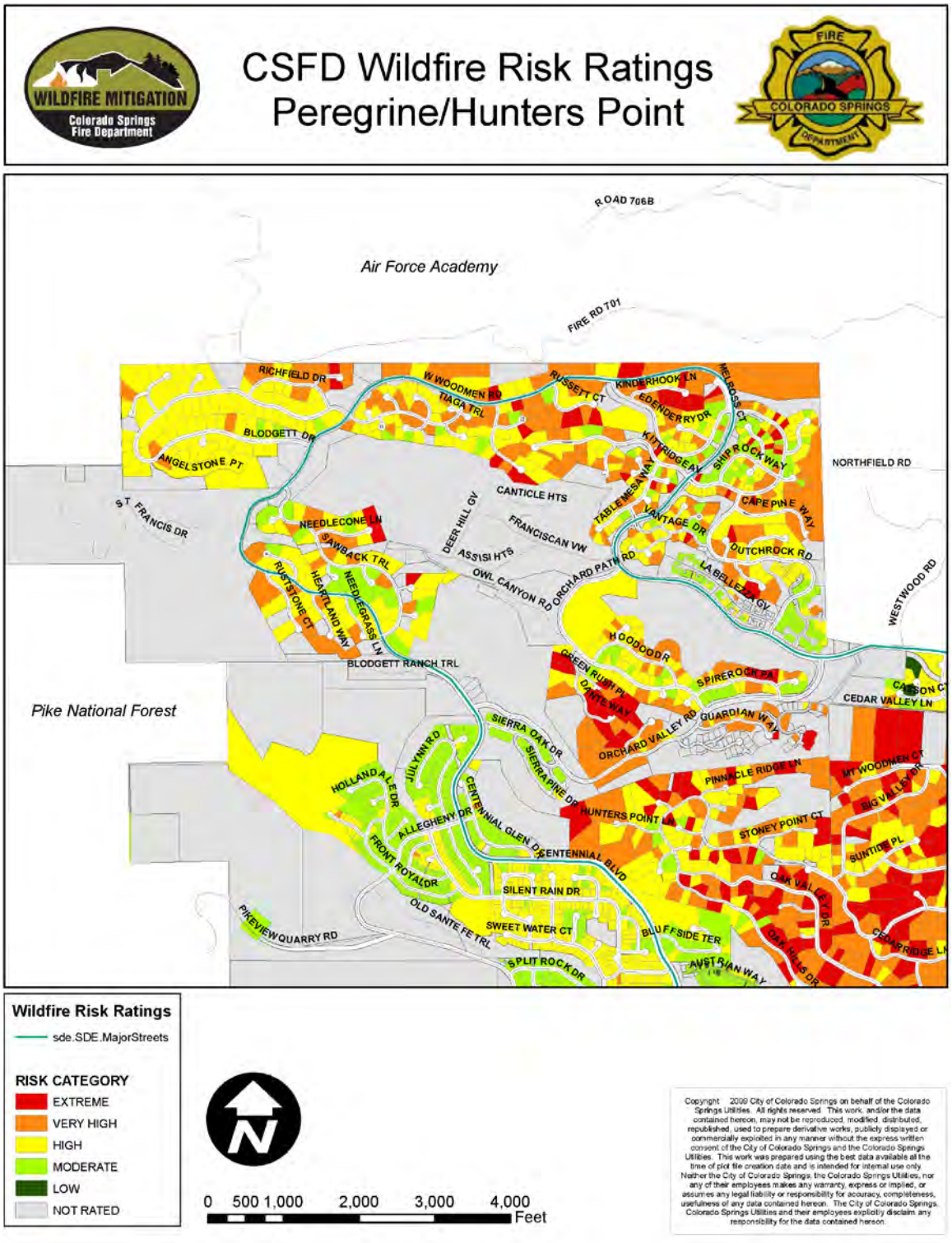


Figure 4-73: Wildfire Risk Ratings – Pinecliff

Figure 4-74: Wildfire Risk Ratings – Pleasant Valley and Vicinity

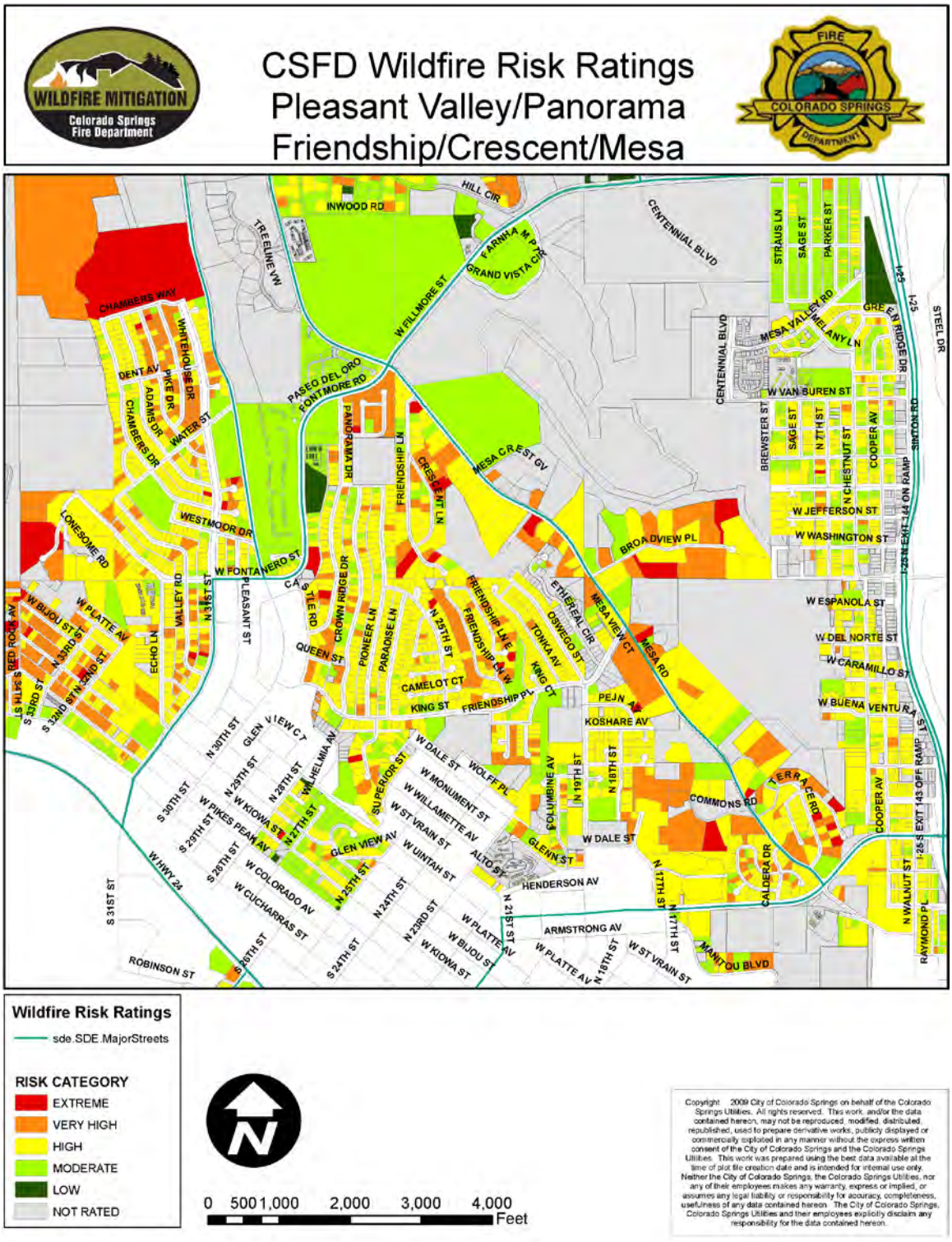


Figure 4-75: Wildfire Risk Ratings – Skyway Vicinity

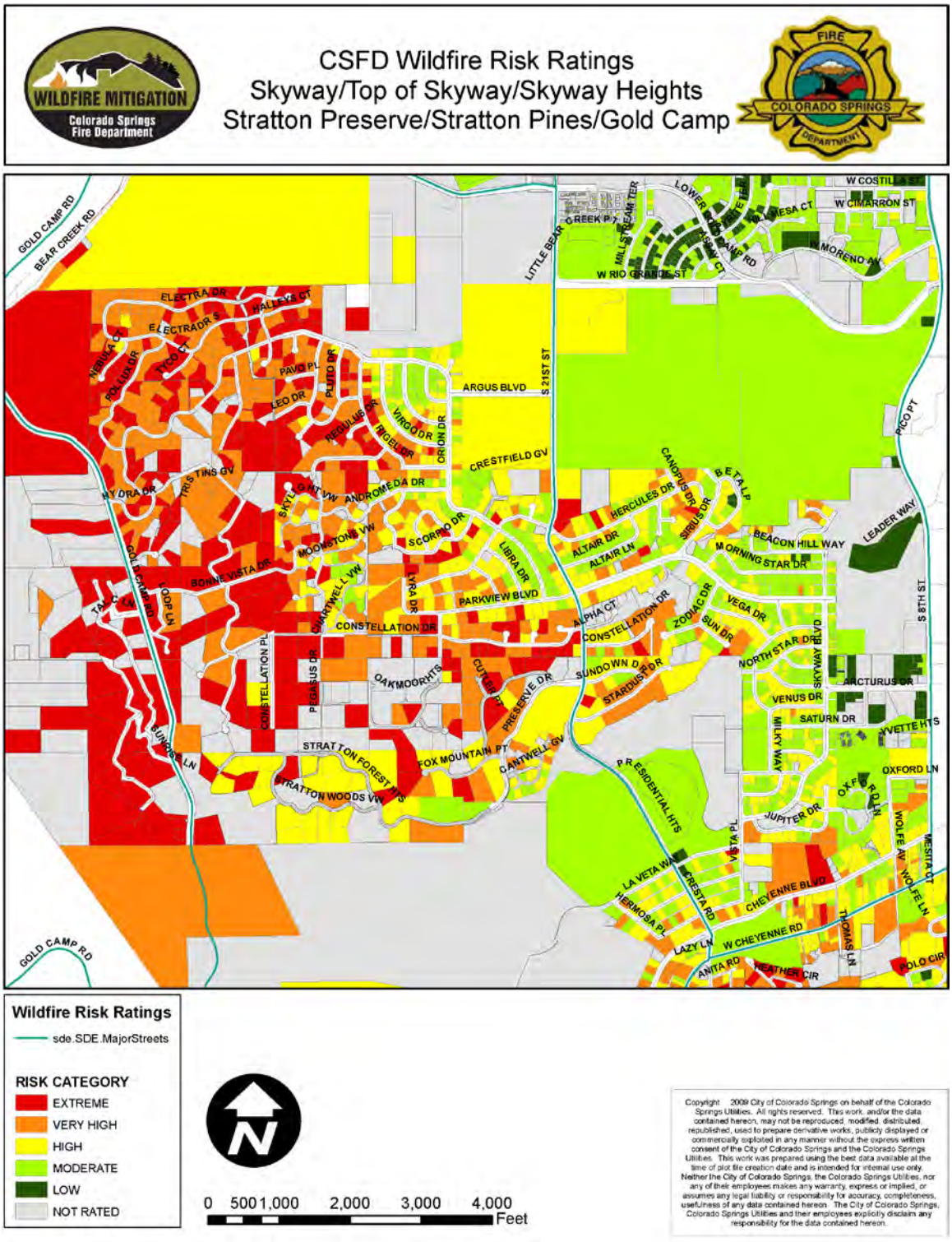
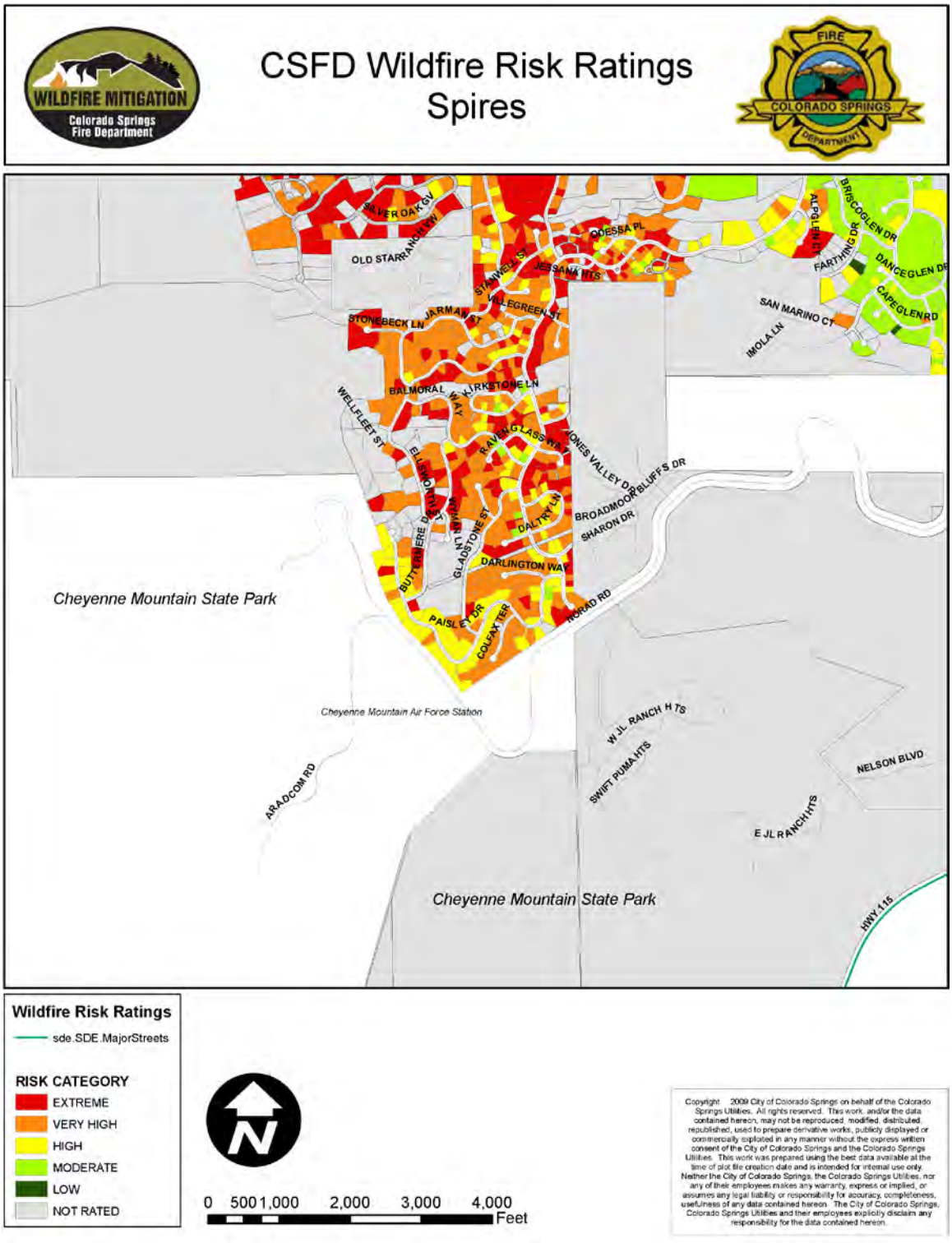


Figure 4-76: Wildfire Risk Ratings – Spires



As stated earlier, approximately 24% of the City of Colorado Springs population resides in the WUI. There are also 30 Parks and Open Spaces in the City that are within the WUI. These areas comprise 10,687.5 acres of the WUI. They are:

- Quail Lake Park (113 acres)
- Bear Creek Park (765.6 acres)
- Garden of the Gods (1,319.1 acres)
- North Cheyenne Canyon (1,276.9 acres)
- North Slope Recreation (2,267 acres)
- Palmer Park (730.7 acres)
- Ute Valley Park (338.4 acres)
- Austin Bluffs / Pulpit Rock Open Space (585.5 acres)
- Blodgett Peak Open Space (167.2 acres)
- Cheyenne Mountain State Park backdrop Open Space (832.5 acres)
- Manitou Section 16 Open Space (634.5 acres)
- Mesa Valley Open Space (41.8 acres)
- Red Rock Canyon Open Space (784.9 acres)
- Rockrimmon Open Space (77.9 acres)
- Sondermann Park Open Space (99.5 acres)
- Stratton Open Space (318.3 acres)
- Sunset Mesa Open Space (78 acres)
- Union Meadows Open Space (31.9 acres)
- Woodmen Valley Open Space (29.6 acres)
- Garden Ranch Open Space (1.6 acres)
- Mesa Open Space (13.6 acres)
- Mountain Shadows Open Space (98 acres)
- Neal Ranch Open Space (35.4 acres)
- Peregrine Open Space (7.5 acres)
- Promontory Pointe (3.7 acres)
- Silent Rain Open Space (2.1 acres)
- Stratton Forest Open Space (22 acres)
- University Park (6.9 acres)
- Vindicator Knob (0.8 acres)
- Winfield Scott Park (3.6 acres)

In addition, the following historical, cultural, or special sites located in high risk areas were identified in the 2005 Plan:

- The Broadmoor
- Cheyenne Mountain Zoo
- North American Aerospace Defense Command (NORAD)
- Will Rogers Shrine
- The Flying W Ranch
- The Cragmoor Sanatorium
- Glen Eyrie
- Rock Ledge Ranch
- Mount Saint Francis
- Helen Hunt Falls
- Seven Falls
- Pulpit Rock
- Starsmore Discovery Center

Secondary Impacts: As described in the Colorado SEOP, there is a strong possibility that the occurrence of a wildfire can increase the risk of future floods as the case with areas downstream of the Waldo Canyon burn scar. Other hazard risks include damage to a HAZMAT facility. It can also impact transportation, trigger urban fires, and cause utility disruption.

Future Development: Building standards can offer only limited protection from fire damage. Increasing population growth and development increases vulnerability to fires, specifically along the foothills. Within the Colorado Springs Division of the Fire Marshal (FM), the CSFD NCA Section provides several services that help reduce wildfire risk. These include community outreach and education, fuels management, stewardship agreements, development review, hazardous activity permitting, fire danger

monitoring, operational support, burn bans and restrictions, grant administration, and a volunteer program. This rigorous mitigation strategy shares responsibilities among agencies, and promotes safer communities in the process.

Data Limitations

Wildfire risk maps are not wholly accurate to the parcel level. Regionally, these maps identify larger areas of concern based on slope, aspect, and fuels; however, each individual parcel may contain more or less fuel, may be implementing defensible space, or may have structures made with considerably stronger materials.

Other Fire Districts in Colorado Springs: In addition to CSFD, there are four other fire protection districts that serve areas within the City limits. They are:

- Black Forest Fire/Rescue Protection District
- Donald Wescott Fire Protection District
- Broadmoor Fire Protection District
- Falcon Fire Protection District

For the purposes of this Plan, only data from CSFD is included. Figure 4-77 shows the fire facility locations in relation to the WUI.

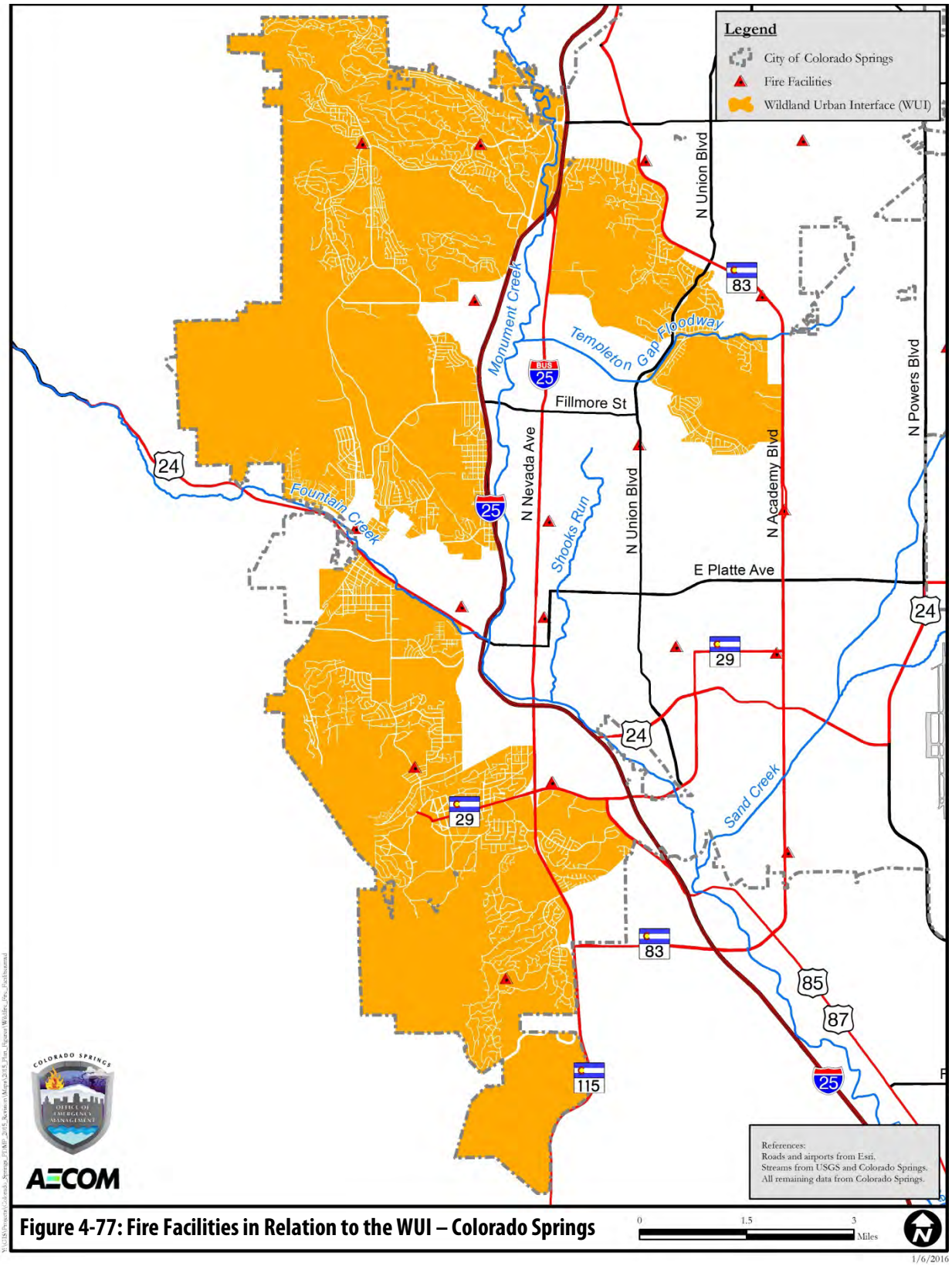


Figure 4-77: Fire Facilities in Relation to the WUI – Colorado Springs

4.7 Human-Caused Hazards

Human-caused hazards refer to threats to life safety and property originating from and caused by people, either inadvertently (from ignorance, accident, or negligence) or intentionally. Human-caused hazards are not generally caused by natural phenomena but infectious disease can definitely be influenced by it. However, due to the fact that infectious disease is greatly influenced by human activity, it is included here. Human-caused hazards for Colorado Springs include:

- Hazardous material incidents
- Terrorism
- Infectious disease

4.7.1 Hazardous Material Incidents

Hazard Description

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways, and on the water.

In 1997, FEMA estimated that approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents, and 266 are due to other causes. The U.S. Department of Transportation Office of Hazardous Material Safety report shows that from 2006 to 2015, there were at least 14,000 HAZMAT incidents a year involving air, highway, railway and water-based transportation. A large majority of these incidents were highway incidents.[38]

In essence, HAZMAT incidents consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

[38] US DOT Pipeline and Hazardous Materials Safety Administration Hazmat Intelligence Portal, at https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Dashboard&NQUser=HazmatWebsiteUser1&NQPassword=HazmatWebsiteUser1&PortalPath=/shared/Public%20Website%20Pages/_portal/10%20Year%20Incident%20Summary%20Reports, Accessed August 23, 2015

Table 4-53: Across the U.S., Top 10 Commodities from 2005-2009 Ranked by Weighted High-Impact Casualties (High Impact Casualties = Fatalities + [Major Injuries or Hospitalizations])

Rank	Commodity Name	High-Impact Casualties (Weighted)	Fatalities	Major Injuries	Incidents
1	Gasoline	33.56	30	19	1,306
2	Chlorine	24.56	9	83	48
3	Diesel fuel	13.31	12	7	573
4	Propylene	4.94	1	21	15
5	Fireworks	4.19	4	1	60
6	Liquefied petroleum gas (LPG)	4.00	1	16	473
7	Carbon dioxide, refrigerated liquid	3.56	3	3	51
8	Sulfuric acid	3.31	2	7	1,269
9	Argon, refrigerated liquid	3.00	3	0	42
10	Propane	3.00	3	0	31

Source: Hazmat Intelligence Portal, U.S. Department of Transportation. Data as of June 22, 2011.[39]

Climate change impacts are not relevant to any human-caused hazards or terrorism.

Geographic Location

A hazardous material incident can occur in a variety of locations and spatial extents. Some incidents (such as a fuel spill) can occur in a small location and impact a small spatial extent. Others, such as the release of toxic chemicals may occur from a small location or source but can spread over large areas.

The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires facilities storing hazardous materials to report those substances annually to the State Emergency Response Commission, the Local Emergency Planning Committee (LEPC), and local fire departments. There are many such facilities located throughout Colorado Springs, though many do not store substances or quantities of such that are considered extremely hazardous. Of greater concern to the emergency management community are those facilities that use or produce toxic chemicals above specific thresholds that pose major threats to human life and safety. These include the 26 Toxic Release Inventory (TRI) facilities in Colorado Springs listed on the U.S. Environmental Protection Agency's (EPA) website, as noted in Table 4-54.

[39] From U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration website, from http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_1C2E377DF0EEC5F87AFAD9A7933DFB24F2541800/filename/09-10%20HM%20Biennial%20Report%20to%20Congress.pdf, accessed June 2015

Table 4-54: EPA's Toxic Release Inventory Quick Facts for 2013

Quick Facts for 2013 – EPA	
Number of TRI Facilities	26
Total Production-Related Waste Managed	1.7 million pounds
Total On-site and Off-site Disposal or Other Releases	885,700 pounds
Total On-site:	233,500 pounds
Air	233,300 pounds
Water	10 pounds
Land	147 pounds
Total Off-site	6,522 pounds

Source: EPA Quick Facts website http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet?pzip=&pstate=CO&pcity=Colorado Springs&pcounty=&pyear=2013&pParent=TRI&pDataSet=TRIQ2, accessed November 4, 2015

The industry listed as contributing the most on-site releases to Colorado Springs is Industry Sector 2211 – Electric Utilities. This industry contributes 73,273 pounds of which 73,200 pounds is air and 74 pounds is land. In this industry, the largest contributor is Martin Drake Power Plant and the primary chemical release is Hydrogen Fluoride (89% of total air releases for the area). Another industry that is a major contributor is Industry Sector 334 – Computers/Electronics Products.

Of the releases to air (233,300 pounds), Hydrogen Fluoride is 31%; Ammonia is 10%; Hydrochloric Acid is 5%; N-Methyl-2-Pyrrolidone is 1%; Methanol is 1%; and Other is 52%. Of the releases to water (10 pounds), 48% is Chromium (no other values reported). No detailed information is provided on EPA's website for off-site releases.

A general history of rail lines in Colorado is captured in a CDOT report entitled *Prioritization of Railroad Corridors for Preservation:*[40]

> *The Colorado rail system currently includes both a freight rail network and a limited passenger rail network. The role of the railroads and rail transportation in the state is to provide efficient transportation choices for the movement of goods and people while connecting effectively to the other transportation modes. The rail system in the state is an interconnected component of much larger regional, national and global multimodal transportation systems and economies.*
>
> *Currently 14 privately owned freight railroads operate in Colorado. These railroads own more than 2,800 miles of track in the state and currently operate on 2,684 miles of those tracks. This represents about 1.9% of the nation's 140,000 miles of network track. The extent of this network is also reflected in the fact that 48 of Colorado's 64 counties are directly served by the freight rail network. There are two Class I railroads in Colorado, BNSF Railways and Union Pacific. Combined they operate over 80% of the miles of track and carry the majority of freight in the state. The freight rail network in the Front Range is currently near capacity and is forecast to be over capacity by 2035.*

[40] From CDOT at https://www.colorado.gov/pacific/sites/default/files/CDOT%20Prioritization%20of%20Railroad%20Corridors%20for%20Preservation.pdf; Accessed June 2015

In addition, there are 12 short line railroads in Colorado comprising 20% of track miles in the state. They primarily provide localized service with connections to the Class I railroads. They principally serve the agricultural industry and are very valuable assets to both local and statewide economies.

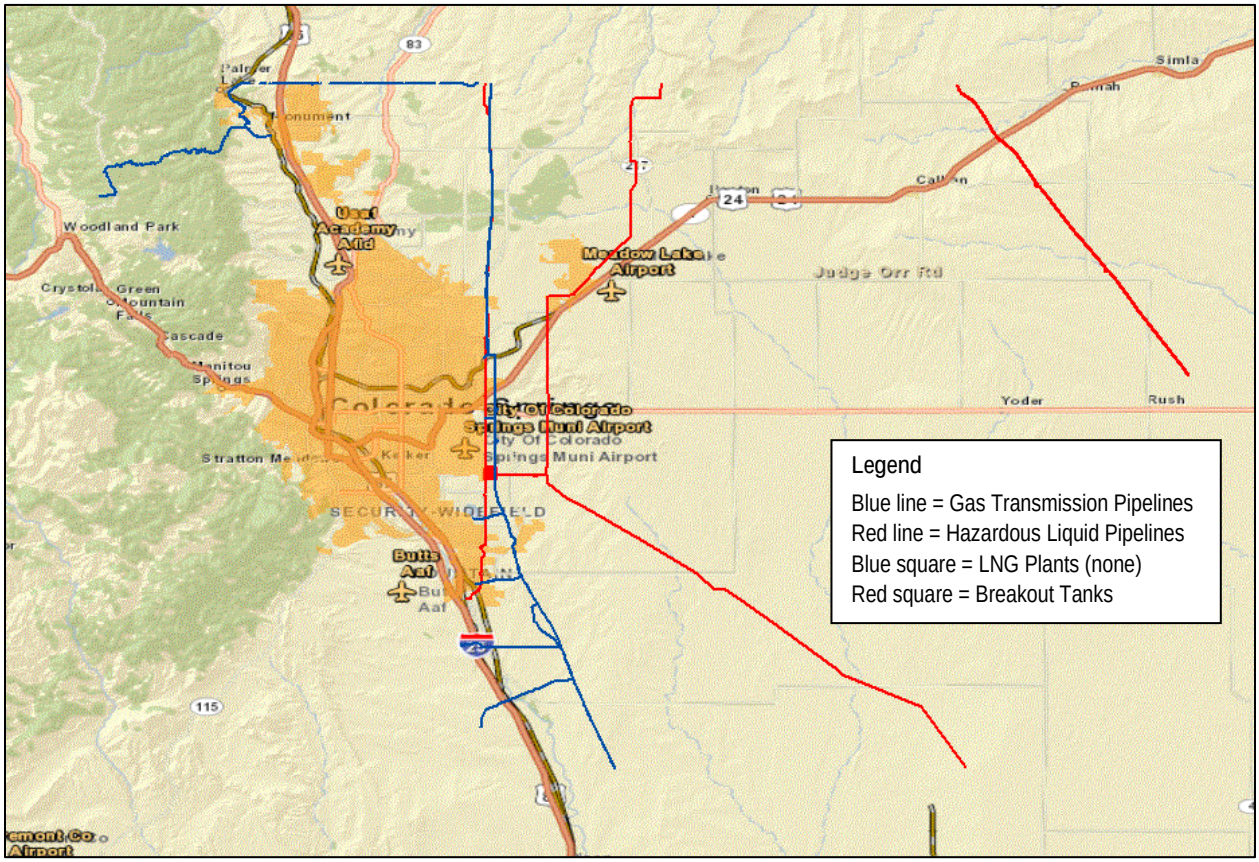
Colorado Springs has both a major interstate, I-25, and a major railway, the Burlington Northern Santa Fe (BNSF) line, that bisect the city north/south. Both of these major transportation routes run north-south along the Front Range and are major corridors for shipments of goods, including hazardous materials and waste. Both I-25 and the railway run through downtown and densely populated areas so any HAZMAT incident on these transportation corridors is a concern for health and safety.

According to the BNSF website, railroads are required by federal law to move hazardous materials and many of these types of products are everyday commodities like paint, batteries, and household cleaning products. A smaller portion (0.3% of all rail shipments) is the materials of greatest concern to emergency management officials. To monitor and respond to any such HAZMAT incidents, BNSF helps train emergency responders across its system and has 160 emergency response personnel who are trained, equipped, and prepared to monitor and respond to any emergency situation involving hazardous materials.

There is a heightened sense of vulnerability to rail traffic due to the shipping of crude petroleum that has resulted in several catastrophic events when derailment occurs (e.g., the Lac-Megantic rail disaster in Canada).

Colorado Springs has one primary natural gas pipeline and one other hazardous liquid pipeline running near the city (Figure 4-78 from the National Pipeline Mapping System [NPMS] website). The City also has one breakout tank which is used to either "relieve surges in a hazardous liquid pipeline system or receive and store hazardous liquid transported by a pipeline for reinjection or continued transportation by pipeline" according to the Pipeline and Hazardous Materials Safety Administration (www.phmsa.dot.gov).

Figure 4-78: NPMS Public Map showing Gas and Hazardous Liquid Pipelines, LNG Plants, and Breakout Tanks



Source: NPMS Public Map Viewer (https://www.npms.phmsa.dot.gov/PublicViewer/composite.jsf)

Previous Occurrences

Colorado Springs averages about 10 reported hazardous material incidents a year. These incidents may be a tanker rollover or other accidental releases of substances during transport.

Table 4-55: Emergency Response Notification System Incidents in Colorado Springs 2005-2014

Type of release	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Fixed site (e.g. incident at a building)	5	6	5	6	4	3	5	6	5	2	47
Continuous Release	0	0	0	1	0	0	0	0	0	0	1
Storage tank, drilling platform, or pipeline	1	1	1	0	2	1	1	0	0	1	8
Unknown sheen on water	0	0	0	0	0	0	0	0	0	1	1
Mobile vehicle (plane, truck, train, ship, etc.)	9	5	4	2	1	4	4	2	8	4	43
Other or unknown	0	0	0	0	0	0	0	0	0	0	0

Type of release	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Reported Property Damage from Incidents	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Number of People Evacuated	0	58	8	0	0	0	0	0	0	12	78
Number of Injuries, Hospitalizations and Fatalities	2	4	2	3	0	2	0	0	0	0	13

Source: RTKNet.org and the Center for Effective Government at http://www.rtknet.org/db/erns/erns.php?citystate=Colorado+Springs%2C+CO using data from the U.S. Coast Guard's Emergency Response Notification System (ERNS) database

Aerial view of April 19, 2015 Colorado Springs train derailment. Source: City of Colorado Springs

On the night of April 19, 2015, a train derailment near Colorado Springs left seven cars on their side and dry ammonia leaking from a couple of the cars. There were 13 cars on the BNSF train. The incident occurred just south of Sierra Madre Street and Fountain Avenue and it appeared that the train may have been travelling too fast to take the curve. The contents of the spill were ammonium sulfate, an ingredient in fertilizer which is much less hazardous than other dry ammonia types. No evacuations were ordered and cleanup was completed in a few days.[41]

Probability of Future Occurrence

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less*

Due to the continuous presence of hazardous materials being transported or stored in and around Colorado Springs, HAZMAT incidents of varying magnitudes are considered "likely" future events.

Climate Change Impacts

The 2014 NCA does not address HAZMAT incidents. There do not appear to be direct links between climate change and HAZMAT incidents.

[41] From KKTV web article, at http://www.kktv.com/home/headlines/Train-Derailment-in-Colorado-Springs-299525991.html; Accessed June 2015

Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours*

Due to the continuous presence of hazardous materials being transported along the railways and interstate through Colorado Springs as well as 26 fixed sites, Colorado Springs had evacuations from HAZMAT incidents three out of the last 10 years. Fatalities from these releases have been rare, but there have been injuries and hospitalizations. A larger scale event, such as an explosion and resulting toxic plume that causes a mass evacuation and multiple fatalities is possible due to the proximity of the rail lines and interstate near densely developed areas, but unlikely.

Vulnerability Assessment

Overall Summary and Impacts: HAZMAT incidents occur every year and there is always the chance for a major incident, especially with major transportation routes carrying materials through downtown and by densely developed areas.

Estimating Potential Losses: Estimated potential losses are difficult to calculate because different hazardous materials have different impacts and other factors such as quantity or surrounding areas that may greatly influence the volatility of the released materials. While explosions involving hazardous materials are possible and would impact any nearby buildings and facilities, it is generally assumed that the greatest risk would be to human health and safety. The populations at greatest risk are those living and working within five miles of I-25 and the railway or the population within five miles of a fixed facility.

Secondary Impacts: The Colorado SEOP shows that there could be several secondary impacts to HAZMAT events including mass casualty and civil disorder. Other impacts would likely be transportation and utility disruption, wildfire and urban fires. The potential for secondary impacts emphasizes the need to contain the initial impacts including quick response and good coordination.

Future Development/Action: The Colorado Springs LEPC's function is to develop emergency planning and help the community prepare for and respond to emergencies involving hazardous substances. LEPC members include local officials including police, fire, civil defense, public health, transportation, and environmental professionals, as well as representatives of facilities subject to the emergency planning requirements, community groups, and the media. Some of the LEPC's tasks include developing an emergency response plan and providing information to citizens about chemicals in the community.

The TRI is a publicly available database from the EPA that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under EPCRA and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; RCRA Subtitle C treatment, storage, and disposal facilities; and solvent recovery services.
- Has 10 or more full-time employee equivalents.

- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, bio-accumulative and toxic chemicals are subject to different thresholds of 10 pounds, 100 pounds, or 0.1 grams depending on the chemical.

Data Limitations

Some information is confidential or proprietary and therefore not accessible. Railroad companies are not required to report transportation of hazardous materials although there is draft legislation prepared, as of August 2015 that could change that.

4.7.2 Terrorism

Hazard Description

Information in this section references the FEMA, State, and Local Mitigation Planning How-to Guide: *Integrating Manmade Hazards into Mitigation Planning* (FEMA Publication 386-7). For the sake of brevity and consistency with other sections of the risk assessment, each element of terrorism is introduced in relatively abbreviated format. According to the U.S. Department of Justice, Federal Bureau of Investigation (FBI), "Terrorism is the unlawful use of force or violence, or threatened use of force or violence, against persons and places for the purpose of intimidation and/or coercing a government, its citizens, or any segment thereof for political or social goals." The FBI further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization; however, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and its consequences.

Terrorism can include computer-based (cyber) attacks and the use of weapons of mass destruction to include chemical, biological, radiological, nuclear, or explosive agents. However, within these general categories, there are many variations. Particularly in the area of biological and chemical weapons, there is a wide variety of agents and ways for them to be disseminated.

The following types of terrorist attacks have been identified by FEMA as part of their guidance on integrating manmade hazards into mitigation planning:

Armed Attack

This element refers primarily to tactical assault or sniping from a remote location.

Arson/Incendiary Attack

Arson/incendiary attack is the initiation of fire or explosion on or near a target either by direct contact or remotely via projectile.

Agri-terrorism

Agri-terrorism is the direct, typically covert contamination of food supplies or the introduction of pests and/or disease agents to crops and livestock.

Biological Agent

Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers.

Chemical Agent

Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles or containers; or munitions.

Conventional Bomb/Improvised Explosive Device

This is the intentional detonation of an explosive device on or near a target with the mode of delivery being a person, vehicle or projectile.

Cyber Attack (criminal or terrorism)

Cyber attack terrorism is an electronic attack using one computer system against another.

Intentional Hazardous Material Release

Solid, liquid, and/or gaseous contaminants may be intentionally released from either fixed or mobile containers.

Nuclear Bomb

A nuclear device may be detonated underground, at the surface, in the air or at high altitude.

Radiological Agent

Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point or line sources such as munitions, covert deposits, and moving sprayers.

Geographic Location

The location of terrorist attacks is unpredictable, although certain critical facilities and venues for large public gatherings are usually considered to have more inherent vulnerability. While not close to coastlines and ports, which typically attract a larger number of visitors and immigrants, Colorado Springs' location along the continually expanding Front Range population provides the type of diverse urban area that adds a layer of anonymity for potential wrongdoers.

International and domestic terrorism remains a significant hazard of concern for most communities across the United States, and became much more so in the aftermath of the September 11, 2001, Al-Qaida attacks in New York City and Washington, DC. More recently, the emergence of the Islamic State of Iraq and Syria (ISIS) is on the forefront of international terrorist concerns.

Colorado Springs, like most major metropolitan communities, has the potential to be a target of a terrorist. The City has a number of iconic sites in its military bases (Fort Carson, Cheyenne Mountain, the Air Force Academy, etc.) that could be

targeted. The Southern Poverty Law Center has identified 15 hate groups based in Colorado with four in Colorado Springs.[42] The recent crisis with ISIS has made military targets a major concern. Other sites of national significance, may represent a target due to location, potential for publicity, and other targeting factors too numerous to mention here. The world is shrinking and geographical boundaries and proximity are no longer major factors.

Armed Attack

This will vary based upon the perpetrators' intent and capabilities. Included in this is the "Active Shooter." This can range from a lone actor attacking a site where people congregate like a mall or movie theater (e.g., Aurora), a school (Columbine High School in Littleton), or a military base (e.g., attacks at Fort Hood, TX in 2009 and 2014) to a systematic, organized attack by multiple, trained individuals with specific targets in mind or to cause as much mayhem as possible.

Arson/Incendiary Attack

The extent of damage is determined by the type and quantity of the device or accelerant used and the materials present at or near the target. Cascading consequences may also occur, such as incremental structural failure, etc.

Agri-terrorism

Generally there are no direct effects on the built environment. Food contamination may be limited to discrete distribution sites. Pests and diseases may be spread widely.

Biological Agent

Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. In the case of infection, infection can be spread via both human and animal vectors.

Chemical Agent

Chemicals may be corrosive or otherwise damaging over time if not remediated. Contamination can be carried outside of the initial target area by persons, vehicles, water, and wind.

Conventional Bomb/Improvised Explosive Device

The extent of damage is determined by the type and quantity of explosive. Effects are generally static with other cascading consequences, such as incremental structural failure, etc.

Cyber Attack

Generally there are no direct effects on the built environment unless illegal entry to a utility is gained via its electronic Supervisory Control and Data Acquisition system.

[42] From the Southern Poverty Law Center Hate Map, found at http://www.splcenter.org/hate-map#s=CO; Accessed June 2015

Intentional Hazardous Material Release

Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination can be carried outside of the initial target area by persons, vehicles, water, and wind.

Nuclear Bomb

Initial light, heat, and blast effects of a subsurface, ground or air burst are static and are determined by the device's characteristics and employment. Fallout or radioactive contaminants may be dynamic, depending on meteorological conditions.

Radiological Agent

Initial effects will be localized to the site of attack. Depending on meteorological conditions, subsequent behavior of radioactive contaminants may be dynamic.

Previous Occurrences

Colorado has not seen many incidents of terrorism, and as of December 2015, there have been no official acts of terrorism in Colorado Springs.

Colorado has been the location of recent spates of individual shooters including the Aurora Movie Theatre massacre and earlier, the Columbine school shooting in Littleton. On November 27, 2015, a gunman attacked a Planned Parenthood clinic in Colorado Springs, resulting in three deaths and nine injured. Numerous emergency service agencies responded to the incident and provided assistance. OEM opened the EOC and provided logistical support for the response and recovery operations.

Probability of Future Occurrence

"Lone" Actor Scenario - Based on Previous Occurrences (Movie Theater shooting; attack at base)

Occasional: *1-10% chance of occurrence in the next year or a recurrence interval of 11 to 100 years*

Significant, Organized Terrorist Attack

Unlikely: *Less than 1% chance of occurrence in the next 100 years or a recurrence interval of greater than every 100 years*

The probability of a future terrorist attack is possible due to the number of potential targets and the current law enforcement efforts underway. The probability of future terrorist attacks is partially monitored by the U.S. Department of Homeland Security through the Homeland Security Advisory System. For more information on this system, visit http://www.whitehouse.gov/homeland/. In Colorado, potential terrorist activities are monitored by the Colorado Springs Police Department (CSPD) with assistance from the FBI Joint Terrorism Task Force and the state fusion center called the Colorado Information Analysis Center (CIAC). Fusion centers are set up across the United States as focal points within the state and local environment for the receipt, analysis, gathering, and sharing of threat-related information and have additional responsibilities related to the coordination of critical operational capabilities. These centers are the priority for the allocation of available federal resources, including the deployment of personnel and connectivity with federal data systems.

Of these threats, the most likely ones in Colorado Springs include active shooter, a potential attack on a military base or infrastructure, and/or cyber-terrorism.

Climate Change Impacts

The 2014 NCA does not address terrorism. There do not appear to be tangible links between climate change and terroristic activity.

Magnitude/Severity

"Lone" Actor Scenario (mentally ill individual or home-grown terrorist) - Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours to* ***Critical:*** *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours*

Significant, Organized Terrorist Attack - Critical: *Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours to* ***Catastrophic:*** *Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and service for more than 72 hours*

The potential scenarios of a terrorist attack vary widely depending on the number of terrorists/attackers involved, the level of weaponry, the sophistication of the strategy, the choice of target, and the response time to the event.

Vulnerability Assessment

Overall Summary and Impacts: Human-caused hazards are no notice events; thus, early focus on coordinated response and recovery efforts is imperative to mitigate damage and impact to the public. As described earlier, there are areas in Colorado Springs that are more likely to be targets for terrorism such as military bases, critical facilities, communication systems, water and utilities, monuments, and areas where large groups congregate (e.g., stadiums, conventions, worship areas). Many human-caused hazards will require extended response and recovery operations and mitigation can be described in terms of preventing additional damage once the initial incident occurs. Initially following any incident, it may be assumed that terrorism is the cause until proven otherwise. As this occurs, there will be a two-pronged response that involves the typical response and recovery operations in addition to the law enforcement investigation to determine the cause. Should terrorism be determined, the typical response and recovery operations will be coupled with a federal terrorism investigation. Additional considerations for a terrorism event include preservation of human evidence in addition to evidence collection and crime scene preservation.

Estimating Potential Losses: It is difficult to estimate potential losses from terrorism attacks because of the tremendous range of potential impact. Losses typically involve injury and fatalities in an armed attack but could also be massive property damage along with human injury if an explosive device is involved. While cyber-attacks may not physically harm a person or damage a building, the violation of secure information can result in massive financial losses or crippling of a system needed to operate an important facility. Future growth in the area could contribute to a slightly higher risk of terrorism as the population grows and is more diverse. Terrorism is highly subjective to events and reactions to events all over the world and is extremely difficult to predict.

Secondary Impacts: The Colorado SEOP states that there could be several secondary impacts to terrorism events including transportation and utility disruption, wildfire and urban fires, dam failure, HAZMAT incident, and infectious disease. The potential for secondary impacts emphasizes the need to contain the initial impacts including quick response and good coordination.

Future Development/Action: Locally, the CSPD will work with state and federal officials to monitor potential threats. The underlying philosophy of the "See Something, Say Something" campaign where everyday citizens can help spot suspicious activity and report it is now widely accepted. Citizens can serve as additional 'eyes and ears' for law enforcement officials in Colorado who often rely on the instincts and perceptions of citizens to detect activity that is out of the ordinary. Of particular interest is recognition of suspicious behavior such as unauthorized individuals who request sensitive information or take photographs of critical infrastructure or sensitive areas without permission. In highly sensitive areas, cameras can be set up to help provide additional surveillance capability to security teams.

Data Limitations

Up-to-date terrorist threats are dynamic and information regarding potential threats is highly secure meaning that neither was available to the preparers of this Plan. Even if information was available, it would not be placed in a Plan that is publicly available. In addition, threats change on a continual basis and any risk published in this plan would quickly become dated.

4.7.3 Infectious Disease

Hazard Description

Infectious Disease is a disease caused by a microorganism or other agent, such as a bacterium, fungus, or virus that enters the body of an organism and is usually contagious in origin. It is usually transmitted by a specific kind of contact with an infected entity or object and rapidly increases in geographic range. The susceptibility to an infectious disease can be universal and widespread over a large geographic area. Infectious diseases are a constant threat to humanity. Societal, environmental, and technological factors impact the occurrence and persistence of infectious diseases worldwide, as new diseases (e.g. SARS, West Nile Virus) continue to emerge each year and old diseases reappear or evolve into new drug-resistant strains (e.g. malaria, tuberculosis, bacterial pneumonias). Infectious diseases can be carried by infected people, animals and insects, and can also be contained within commercial shipments of contaminated food.

Three terms are commonly used to classify disease impacts: endemic, epidemic, and pandemic. An endemic is present at all times at a low frequency (e.g. chicken pox in the U.S.). An epidemic is a sudden severe outbreak of disease (e.g. the bubonic plague during Medieval times), and a pandemic is an epidemic that becomes very widespread and affects a whole region, a continent, or the world (e.g. the 1957 flu pandemic caused at least 70,000 deaths in the U.S. and 1-2 million deaths worldwide.). Fears of a pandemic have risen in recent years as our globalized economy and growing population fosters large scale international travel and trade. Also, growing populations increase the vulnerability of all areas to disease as it can travel more quickly and create difficulty in preventing the spread of infection.

Geographic Location

Disease impacts all areas of the world, and all areas are vulnerable. Third world countries have fewer resources to fight disease and may be more vulnerable than more industrialized nations. In the United States, the public health system works at the federal, state, and local levels to monitor diseases, plan and prepare for outbreaks, and prevent epidemics where possible. But,

in the age of air travel and worldwide shipping, it is becoming increasingly difficult to contain localized outbreaks as infected or exposed people travel and work, sending the disease across the globe in a matter of hours.

Previous Occurrences

Although treatments such as antibiotics, antivirals, antifungals, and anti-parasitics could serve to prevent or lessen the effects of an infectious disease there is still the possibility of significant harm to populations to include the potential for mass fatalities. The occurrence of an infectious disease cannot be predicted with certainty but the State of Colorado has experienced four notable infectious disease outbreaks in the past. The Colorado Department of Public Health and Environment (CDPHE) and the El Paso County Public Health (EPCPH) Department, which serves Colorado Springs, maintain disease surveillance for the City, reporting all known medical diagnoses of certain diseases. For 2014, El Paso County summarized selected reportable diseases/conditions which are listed in Table 4-56.

In January 2015, a Colorado Springs resident was diagnosed with the first measles case in the City since 1992. The resident was linked to the Disneyland (CA) measles outbreak and likely exposed at least 300 other people to the disease. The El Paso Public Health Department and Penrose Hospital proactively provided information on the case and identified at-risk people out of 250 who could not provide proof of immunity. These individuals were 'quarantined' at their homes for several days to reduce exposure to other people.

Table 4-56: 2014 Summary of Selected Reportable Diseases/Conditions in El Paso County

Reportable Communicable Disease	Total Reported Cases in El Paso County	Rate per 100,000 in El Paso County*
Campylobacteriosis	58	8.9
Carbapenem Nonsusceptible Enterobacteriaceae (CRE)	4	0.6
Cholera	1	0.2
Creutzfeldt-Jakob Disease (CJD)	1	0.2
Cryptosporidiosis	6	0.9
Giardiasis	47	7.2
Haemophilus Influenzae	6	0.9
Hemolytic Uremic Syndrome	1	0.2
Hepatitis A	0	0.0
Hepatitis B, Acute	1	0.0
Infant Botulism	2	0.3
Influenza Associated Hospitalizations (September 29, 2013 – May 24, 2014)	211	32.2
Human Rabies	0	0.0
Legionellosis	3	0.5
Listeriosis	2	0.3
Malaria	3	0.5
Measles	0	0.0
Meningococcal Disease	2	0.3
Mumps	0	0.0

Reportable Communicable Disease	Total Reported Cases in El Paso County	Rate per 100,000 in El Paso County*
Norovirus	1090	165.4
Pertussis (Whooping Cough)	56	8.5
Q Fever	1	0.2
Relapsing Fever	1	0.2
Rocky Mountain Spotted Fever	1	0.2
Salmonellosis	64	9.8
Shiga-Toxin Producing E. Coli (STEC)	16	2.4
Shigellosis	4	0.6
Streptococcus Pneumonia Invasive	47	7.2
Tuberculosis	1	0.2
Typhoid Fever	1	0.2
Varicella (Chicken Pox)	42	6.4
West Nile Virus	2	0.3
Total:	**1,674**	-

*Population denominator data is from the Colorado Department of Local Affairs.
Source: El Paso County Public Health Microbe Monthly Communicable Disease Report at http://www.elpasocountyhealth.org/sites/default/files/resources/articles-publications/MicrobeMonthlyMarch_2015.pdf, Accessed July 1, 2015

Probability of Future Occurrence

Likely: *10-100% chance of occurrence next year or a recurrence interval of 10 years or less*

The potential likelihood of an infectious disease event affecting Colorado Springs is estimated at about 4% each year with a recurrence interval of 11 to 100 years.

Historical evidence shows that the population of Colorado Springs, like most large cities, is vulnerable to disease outbreak, and it is somewhat probable that epidemics of infectious disease will impact Colorado Springs in the future. State and local public health officials maintain surveillance in hopes of identifying disease prominence and containing potential threats before they become epidemics.

Climate Change Impacts

Future climate scenarios are predicted to be warmer and dryer which could mean the introduction of diseases typically associated with warmer climates. One example is the mosquito-borne disease chikungunya. Any newer disease would be of great concern because of a lack of immunity and previous exposure by the general population.

Magnitude/Severity

Limited: *Minor injuries and illnesses; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours*

Due to its higher population and number of people traveling to the area from other places for tourism, business or military duty, the chance of an infectious disease spreading is relatively high compared to the typical U.S. city.

Vulnerability Assessment

Overall Summary and Impacts: Infectious diseases occur in small numbers every year and there is always the chance for a major outbreak, especially in urban areas with many travelers coming to and from other places, both nationally and internationally.

Estimating Potential Losses: Estimated potential losses are difficult to calculate because infectious disease causes little damage to the built environment; damage is generally experienced through public health response and medical costs as well as lost wages by patients. Therefore, it is assumed that all buildings and facilities are exposed to disease but would experience negligible damage in the occurrence of an outbreak, but the costs to the public health sector for responding to an outbreak as well as the impact to humans may be great.

Secondary Impacts: The Colorado SEOP does not address infectious disease. Secondary impacts could include civil disorder and mass casualty.

Future Development/Action: Hand washing is an effective means of preventing the spread of many diseases, including colds, Influenza, Norovirus, and Shigellosis. Increasing participation in immunization programs will help decrease the vulnerability of some portions of the population to vaccine-preventable diseases. Additional prevention measures continue to be taken in Colorado Springs in compliance with Colorado immunization laws. To receive a certificate of immunization, children in K-12 schools must receive Pertussis, Tetanus/Diphtheria, Polio, Measles/Mumps/Rubella, Varicella and Hepatitis B. Other recommended, but not required, vaccinations include Influenza, Meningococcal Meningitis, Human Papillomavirus, and Hepatitis A.[43]

The EPCPH Department monitors and provides warnings of potential communicable diseases that can be transmitted from animals like West Nile Virus, Rabies, Hantavirus, Plague, and Tularemia. A growing population in Colorado Springs and El Paso County and development that occurs in wildlands can mean more potential for transmission of infectious diseases through denser population and more interaction with wild animals. The Centers for Disease Control (CDC) monitors disease outbreaks nationally and internationally. A visit to the CDC's website in July 2015 (http://www.cdc.gov/outbreaks/) shows information on national outbreaks of Meningococcal Disease in Chicago, Salmonella, Acute Flaccid Myelitis, and Cyclosporiasis in Texas. The CDC website provides information for Colorado Springs to help monitor potential outbreaks in other areas and what steps to take to address it.

Data Limitations

Some information is confidential or proprietary and therefore not accessible.

[43] From El Paso County Public Health Department, at http://www.elpasocountyhealth.org/sites/default/files/imce/Parent%20Letter%20with%20Charts%20K-12%20English%202014-15.pdf, Accessed July 2, 2015

4.8 Hazard Profile Summary

This section summarizes the results of the hazard profiles and assigns an overall risk ranking of low, moderate, or high to each hazard. This ranking was determined from the hazard profile, focusing on frequency and resulting damage, including deaths/injuries and property, crop, and economic damage. This ranking was used by the LPC to prioritize hazards of greatest significance to the planning area, thus enabling the City to focus resources where they are most needed. Table 4-57 summarizes the overall hazard risk ranking for the City of Colorado Springs. Rankings were influenced by the results of surveys taken by the LPC, stakeholders, and the public.

Table 4-57: Overall Risk Ranking of Hazards

Hazard	Probability	Magnitude	Risk Ranking
Wildfire	Likely	Critical	1
Severe Weather (Drought, Hail, Lightning, Tornado, Windstorm, and Severe Winter Storm)	Highly Likely	Limited to Critical	2
Flood / Dam and Levee Failure	Likely / Unlikely	Critical to Catastrophic	3
Human-Caused Hazards (Hazardous Materials, Infectious Disease, and Terrorism)	Occasional	Limited to Critical	4
Geologic Hazards (Earthquake and Landslides)	Occasional to Likely	Limited to Critical	5

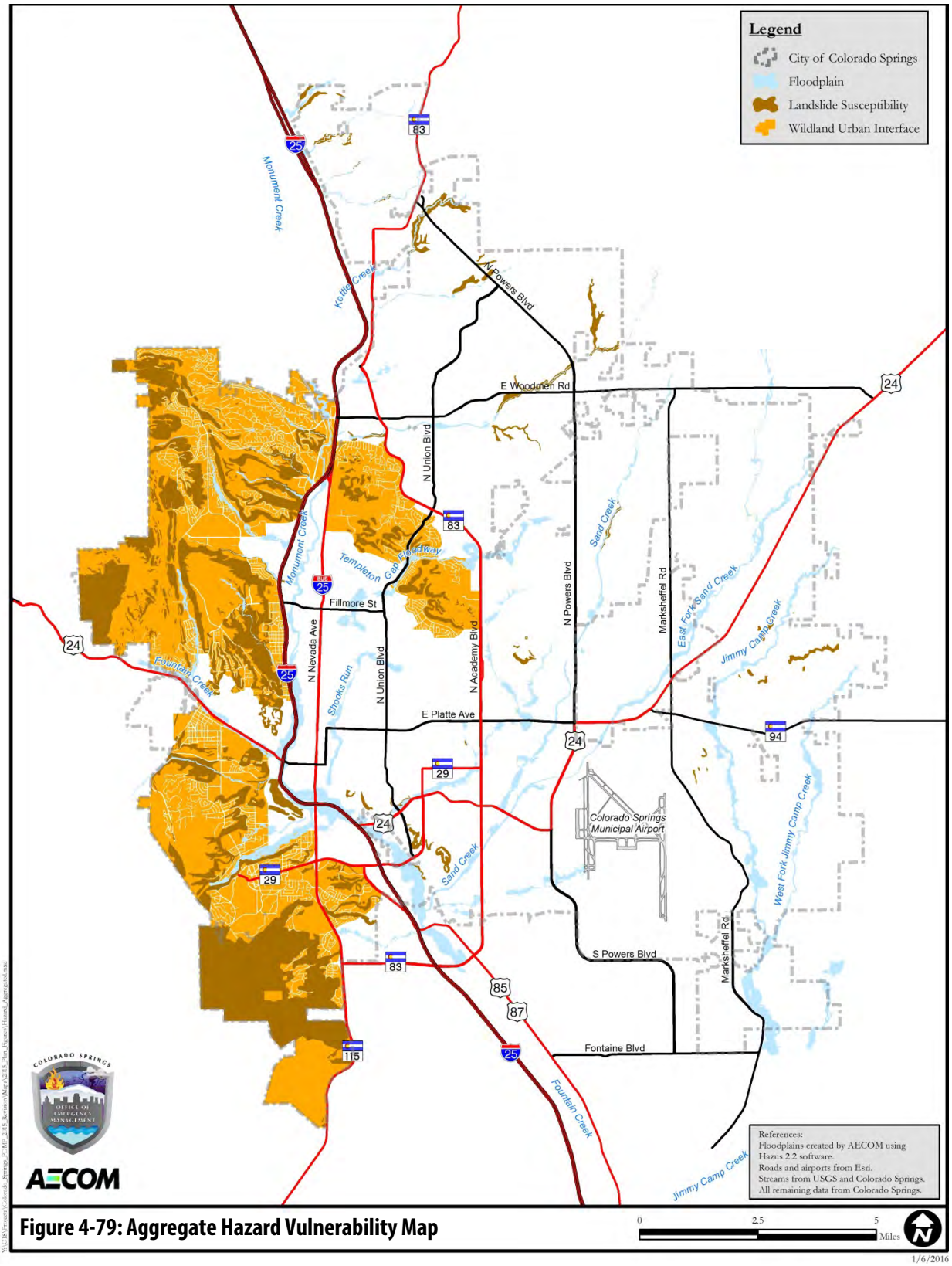


Figure 4-79: Aggregate Hazard Vulnerability Map

4.9 Community Asset Inventory

This section identifies the assets within the City of Colorado Springs that could potentially be impacted by hazards. By identifying these assets, the City of Colorado Springs gains a better understanding of how a particular hazard event may impact the community. This section addresses EMAP Standard 4.3.2.

There are 189,418 buildings in the City of Colorado Springs ranging from office buildings downtown to sheds on agricultural parcels.[44] Depending on the natural hazard, each building is potentially at risk of being damaged.

Figure 4-80 shows population density within Colorado Springs. The areas in dark red shading have a population density of 9.44 to 14.15 people per acre. In increasingly lighter shades, the population decreases: 6.74 to 9.43, 4.28 to 6.73, 1.58 to 4.27, and 0.01 to 1.57.

Future annexations, improved markets, and higher employment rates would likely lead to an increase in new construction in the future. Table 4-58 illustrates the downward trend, beginning in 2006, in building permits issued for new construction in the City of Colorado Springs. This can be largely attributed to periods of severe economic recession starting in 2008. In 2012, the number of permits started to increase again.

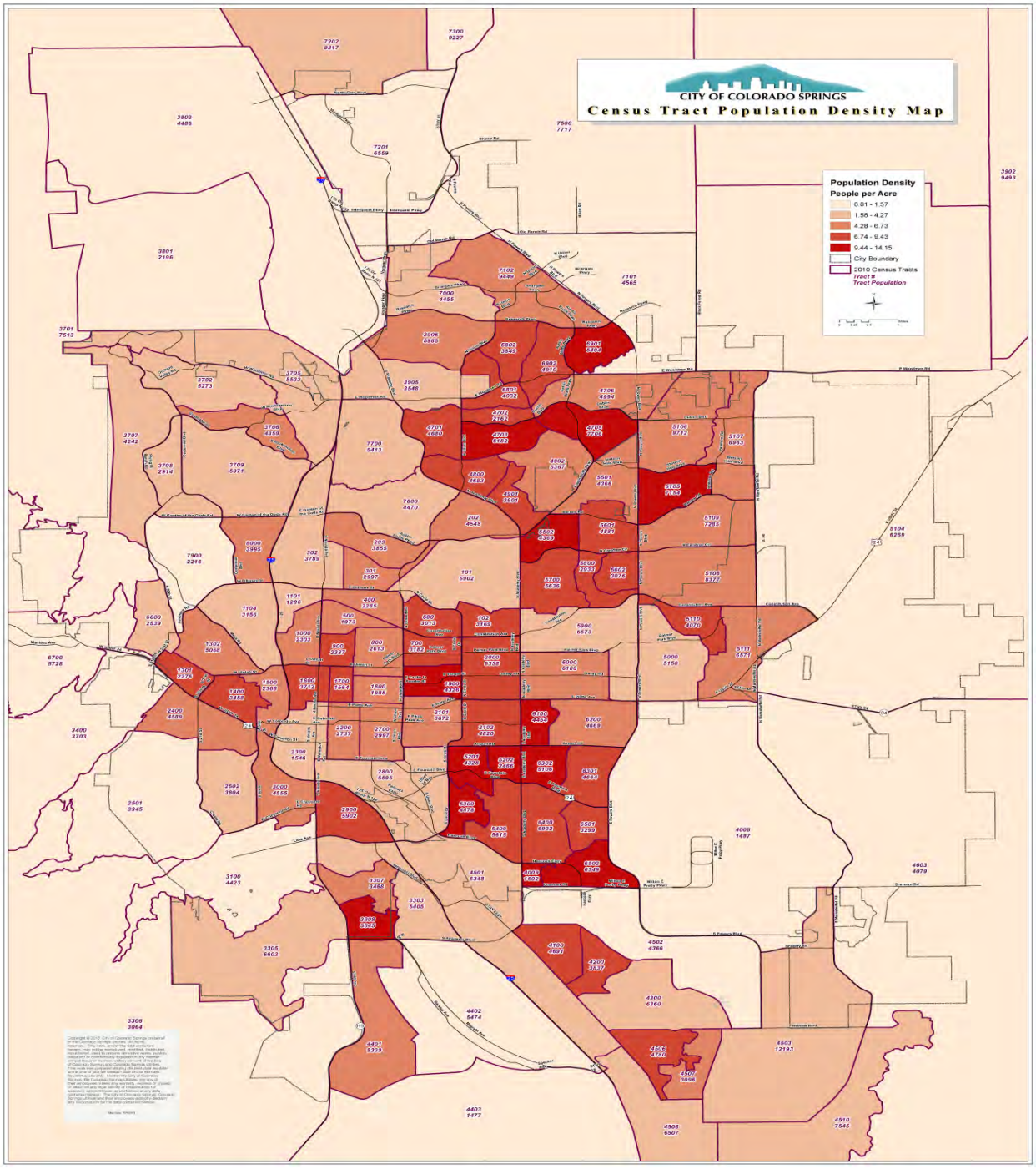
Table 4-58: Permits Issued for Colorado Springs, 2004-2014

Year	Single-Family Residential	New Commercial
2004	5,789	2,480
2005	6,269	2,550
2006	4,148	2,335
2007	2,686	2,505
2008	1,547	1,998
2009	1,315	1,047
2010	1,629	722
2011	1,563	666
2012	2,390	1,137
2013	2,859	1,155
2014	2,590	1,311

Source: Pikes Peak Regional Building Department, http://www.pprbd.org/PublicAccess/Charts.aspx, accessed on August 19, 2015.

[44] According to City GIS data provided to the consultant.

Figure 4-80: Population Density Map for Colorado Springs, 2013



Source: City of Colorado Springs, https://coloradosprings.gov/sites/default/files/planning/census_tracts_2010_07oct.pdf , accessed on June 10, 2015.

Critical Facilities and Infrastructure

Critical (or essential) facilities can be described as services, places, or key infrastructure and resources that are integral for day-to-day operations for the function of the city. These facilities are especially important to the city during and after a hazard event. Critical facilities include hospitals, schools, fire stations, and many others. Critical facilities typically fall within the categories in Table 4-59. Figure 4-81 shows the distribution of critical facilities throughout the City.

There are more bridges in El Paso County (655) than any other county in Colorado.

Source: National Bridge Inventory, http://www.fhwa.dot.gov/bridge/nbi/no10/county14.cfm#co, accessed on November 4, 2015.

Table 4-59: Critical Facilities by Category

Category/Sector	Examples
Water	Reservoirs, stormwater system, wastewater facilities
Emergency Services	Fire stations, police stations, etc.
Communications	Telephone lines, radio towers, cellular service
Gas/Electric	Natural gas lines, power lines, gasoline stations
Healthcare and Public Health	Hospitals, urgent care facilities, doctors' offices
Food/Grocery	Restaurants, grocery stores, markets
Transportation	Major roads, bridges, bus stations, airports
Banking	Banks and other financial institutions
Government Facilities	City hall, jails, military installations
Nearby Dams	Dams (private and public)
Computer Driven Technology	Fiber-optic and cable
Nuclear Materials/Waste	Nuclear power plant, waste storage facility
Chemical Facilities	Propane storage, other chemical storage
Defense Industry Contractors	Staff support services to military installation
Postal or Shipping	U.S. Postal Service offices, FedEx, UPS, others
Critical Manufacturing	Manufacturing critical to local economy
Monuments and Icons	Historical buildings, natural features, local icons
Places of Assembly	Churches, public squares

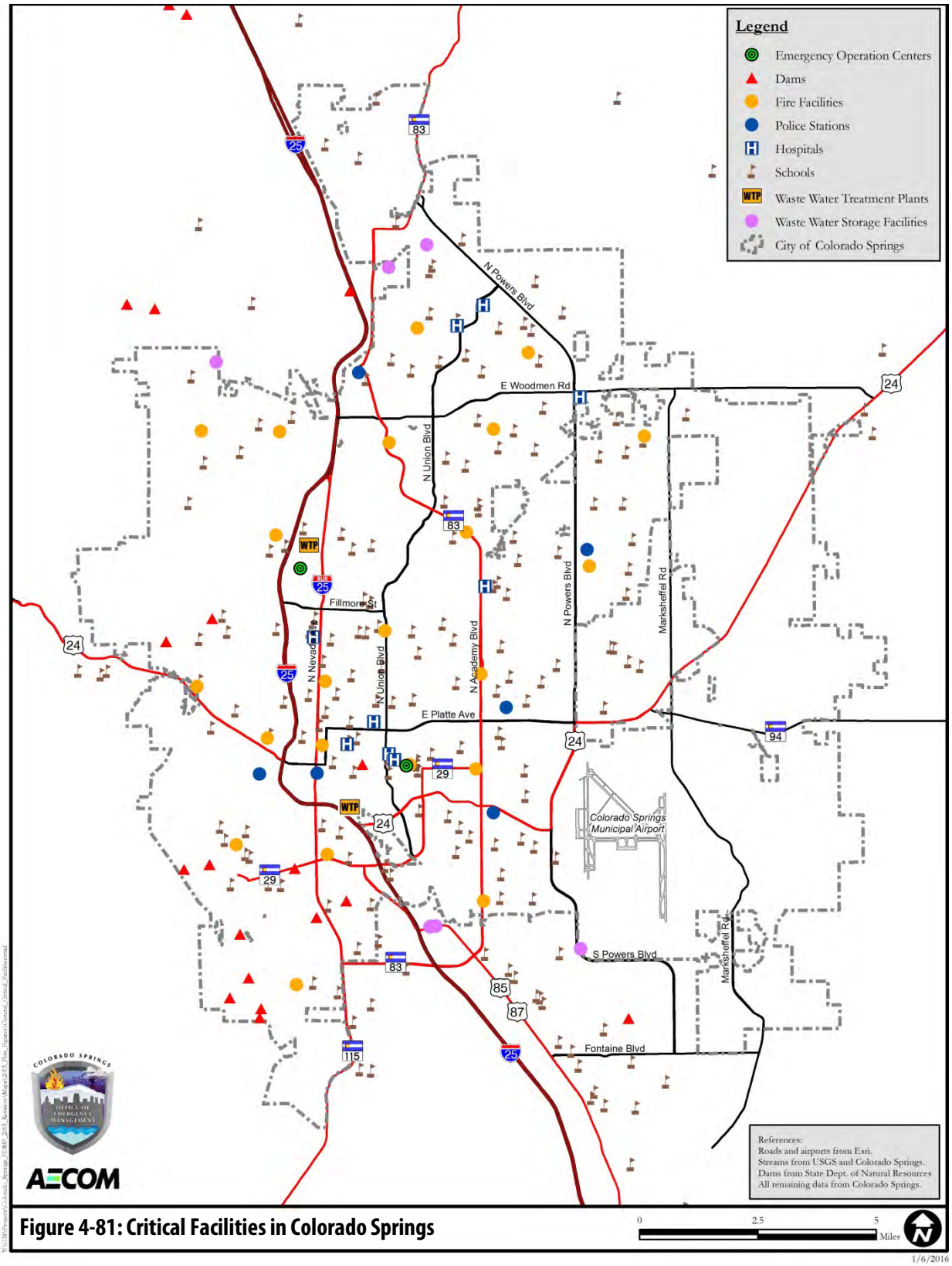


Figure 4-81: Critical Facilities in Colorado Springs

Natural, Historic, and Cultural Assets

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

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

Natural Resources: Wetlands and Endangered Species

Natural resources are important to include in a benefit-cost analyses for future projects. They may be used to leverage additional funding for projects that contribute to other community goals as well. A number of natural resources exist in Colorado Springs. The following discussion comes from data regarding wetlands and endangered species in El Paso County.

Wetlands are a valuable natural resource for communities, due to their ability to improve water quality, wildlife protection, recreation, and education, and play an important role in hazard mitigation. Wetlands reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. Wetlands also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation is vital.

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

According to the U.S. Fish and Wildlife Service (USFWS), as of August 2015, there were 11 Federal endangered, threatened, recovery, experimental population, or candidate species in El Paso County. These species are listed in Table 4-60.

Table 4-60: List of Rare Species in El Paso County

Common Name	Scientific Name	Type of Species	Status
American peregrine falcon	*Falco peregrinus anatum*	Bird	Recovery
Arkansas darter	*Etheostoma cragini*	Fish	Candidate
Bald eagle	*Haliaeetus leucocephalus*	Bird	Recovery
Greenback cutthroat trout	*Oncorhynchus clarki stomias*	Fish	Threatened
Least tern (interior population)	*Sternula antillarum*	Bird	Endangered
Mexican spotted owl	*Strix occidentalis lucida*	Bird	Threatened
Pawnee montane skipper	*Hesperia leonardus montana*	Insect	Threatened
Piping plover	*Charadrius melodus*	Bird	Threatened
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Mammal	Threatened
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	Flora	Threatened
Whooping crane	*Grus americana*	Bird	Experimental Population

Source: USFWS Environmental Conservation Online System for El Paso, CO (August 2015), , http://ecos.fws.gov/tess_public/reports/species-by-current-range-county?fips=08041. This list does not include species with range unrefined past the state level.

Historical and Cultural Resources

National and state historic inventories were reviewed to identify historic and cultural assets in Colorado Springs. The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation. The Colorado State Register of Historic Properties is a listing of the state's significant cultural resources worthy of preservation for the future education and enjoyment of Colorado's residents and visitors. Table 4-61 lists the properties in Colorado Springs that are either on the Colorado State Register of Historic Properties or on the National Register of Historic Places (National Register Properties are indicated with an asterisk). From 2009 to August 15, 2015, there have been 11 new state and federal register listings.

Table 4-61: Colorado Springs Historic Properties/Districts in State and National Registers

	Property Name	Location	Date Listed
1	Alamo Hotel*	128 Tejon Street	9/14/77
2	All Souls Unitarian Church	730 North Tejon Street	8/30/07
3	Atchison, Topeka & Santa Fe Depot*	555 East Pikes Peak Avenue	9/10/79
4	Bemis Hall*	920 North Cascade Avenue	3/28/97
5	Bemis House/Hearthstone Inn*	506 North Cascade Avenue	9/14/79
6	Boulder Crescent Place Historic District*	9 and 11 West Boulder Street 312, 318 and 320 North Cascade Avenue	9/10/87
7	Burgess House*	730 North Nevada Avenue	9/13/90
8	Carlton House*	U.S. Air Force Academy, Pine Valley	11/3/89
9	Chadbourn Spanish Gospel Mission*	402 South Conejos Street	1/14/2009
10	Chambers Ranch/White House (Rock Ledge Ranch)*	3202 Chambers Way	11/29/79
11	City Hall Of Colorado City*	2902 West Colorado Avenue	6/3/82

	Property Name	Location	Date Listed
12	Claremont/Trianon (The Colorado Springs School)*	21 Broadmoor Avenue	4/13/77
13	Colorado School for the Deaf and Blind	33 North Institute Street	3/11/98
14	Colorado Springs & Cripple Creek District Railway/Corley Mtn. Hwy.*	U.S. Forest Service Road 370	3/25/1999
15	Colorado Springs & Interurban Railway (CS&IR) Streetcar No. 48	2333 Steel Drive	2/24/2011
16	Colorado Springs City Auditorium*	231 East Kiowa Street	11/7/95
17	Colorado Springs City Hall*	107 Nevada Avenue	2/19/02
18	Colorado Springs Day Nursery*	104 East Rio Grande Street	2/23/90
19	Colorado Springs Fine Arts Center*	30 West Dale Street	7/3/86
20	Colorado Springs & Interurban Car No. 59	Rock Island Roundhouse	11/9/94
21	Colorado Springs Post Office & Federal Courthouse*	210 Pikes Peak Avenue	1/22/86
22	Colorado Springs Public Library/Carnegie Building*	21 West Kiowa Street	11/1/96
23	Cossitt Memorial Hall*	906 North Cascade Avenue, Colorado College Campus	3/28/97
24	Cottonwood Creek Bridge*	On Vincent Drive over Cottonwood Creek	10/12/01
25	Cutler Hall*	912 North Cascade Avenue, Colorado College Campus	7/3/86
26	De Graff Building*	116-118 North Tejon Street	8/18/83
27	Denver & Rio Grande Western Boxcar No. 60294	2333 Steel Street	2/26/09
28	Dick-Trapp House	714 South Nevada Avenue	2/22/07
29	Edgeplain*	1106 North Nevada Avenue, Colorado College Campus	11/21/06
30	El Paso County Courthouse (Pioneers Museum)*	215 South Tejon Street	9/29/72
31	El Pomar Estate*	1661 Mesa Avenue	11/22/95
32	Emmanuel Presbyterian Church*	419 Mesa Road	5/17/84
33	Evergreen Cemetery*	1005 South Hancock Avenue	2/11/93
34	F. C. Austin Manufacturing Company Sprinkler Wagon	Rock Ledge Ranch	3/8/2000
35	First Baptist Church of Colorado City (Old Colorado City History Center)	1 South 24th Street	6/14/95
36	First Congregational Church*	20 East Saint Vrain Street	10/31/2002
37	First Lutheran Church	301 East Platte Avenue	7/13/1994
38	Fort Collins Municipal Railway No. 22*	2333 Steel Drive	12/15/2011
39	Giddings Building*	101 North Tejon Street	4/21/83
40	Glen Eyrie*	3820 North 30th Street	4/21/1975
41	Grace & Saint Stephen's Episcopal Church*	631 North Tejon Street	12/15/2011
42	Gwynne-Love House*	730 North Cascade Avenue	2/5/1987

	Property Name	Location	Date Listed
43	Hagerman Mansion*	610 North Cascade Avenue	9/20/1984
44	Herschell Ideal Two-Abreast Carousel (Cheyenne Mountain Zoo Carousel)	4250 Cheyenne Mountain Zoo Road	9/10/1997
45	Jackson House	1029 North Nevada Avenue, Colorado College Campus	12/8/1999
46	Lennox House*	1001 North Nevada Avenue, Colorado College Campus	8/11/1999 10/21/1999
47	Lindley-Johnson-Vanderhoof House*	1130 North Cascade Avenue	12/3/2013
48	Los Angeles Railway Streetcar No. 3101	2333 Steel Drive	2/24/2011
49	Lowell Elementary School	831 South Nevada Avenue	3/8/1995
50	Maytag Aircraft Building*	701 South Cascade Avenue	12/16/2005 1/16/2008
51	McAllister House*	423 North Cascade Avenue	8/14/1973
52	McGregor Hall*	930 North Cascade Avenue, Colorado College Campus	1/27/2000
53	Clark Mellen Apartments	218-232½ East Fountain Boulevard	8/11/1993
54	Midland Terminal Railroad Roundhouse (Van Briggle Art Pottery)*	600 South 21st Street	7/10/1979
55	Montgomery Hall*	1030 North Cascade Avenue, Colorado College campus	9/13/1990
56	Monument Valley Park*	Approximately bounded by Monroe, Culebra, Westview and Bijou Streets, the BNSF railroad tracks, and the west edge of the north-south trail, north of West Del Norte Street	1/25/2007
57	Navajo Hogan*	2817 North Nevada Avenue	9/13/1990
58	North End Historic District*	Bounded by Monument Valley, Wood, Nevada, Madison & Uintah Streets	12/17/1982
59	North Weber Street-Wahsatch Avenue Residential District*	North Weber Street between Boulder Street & Del Norte Street	2/8/1985
60	Old Colorado City Historic Commercial District*	North side of Colorado Avenue from 24th Street to 2611 Colorado Avenue, also includes 115 South 26th Street and 2418 West Pikes Peak Ave.	11/2/1982
61	Original Colorado Springs Municipal Airport (Peterson Air & Space Museum)*	150 East Ent Avenue, Peterson Air Force Base	11/15/1996
62	Palmer Hall*	116 East San Rafael Street, Colorado College campus	7/3/1986
63	Pauline Chapel*	2 Park Avenue.	2/26/2001
64	People's Methodist Episcopal Church*	527 East Saint Vrain Street	7/25/2014
65	Pikes Peak*	Pike National Forest, 15 miles west of Colorado Springs	7/4/1961 10/15/1966
66	Pioneer Cabin*	U.S. Air Force Academy	1/27/1975
67	Plaza Hotel*	830 North Tejon Street	9/1/1983
68	Ponderosa Lodge*	La Foret Conference and Retreat Center 6145 Shoup Road, Colorado Springs vicinity	8/29/2008

	Property Name	Location	Date Listed
69	Reynolds Ranch	225 North Gate Road, Colorado Springs vicinity	9/10/1997
70	Ida M. Rice House*	1196 North Cascade Avenue, Colorado College Campus	11/21/2006
71	Rio Grande Engine No. 168*	9 South Sierra Madre Street	8/10/1979
72	Second Midland School/Old Midland School*	815 South 25th Street	9/12/1980
73	Shove Memorial Chapel*	1010 North Nevada Avenue, Colorado College	5/22/2005
74	Shrine of the Sun (Will Rogers Shrine)*	4250 Cheyenne Mountain Zoo Road	11/3/1994
75	St. Mary's Catholic Church*	26 West Kiowa Street	6/3/1982
76	Stockbridge House (Amarillo Motel)*	2801 West Colorado Avenue	9/11/1980
77	Taylor Memorial Chapel*	6145 Shoup Road, Colorado Springs vicinity	4/15/1999
78	Ticknor Hall*	926 North Cascade Avenue, Colorado College Campus	1/27/2000
79	United States Air Force Academy, Cadet Area*	Roughly between Cadet Drive and Faculty Drive, U.S. Air Force Academy	4/1/2004
80	Van Briggle Pottery Company*	1125 Glen Avenue and 231 West Uintah Street, Colorado College Campus	4/29/2009
81	Verner Z. Reed Memorial Library	502 South Tejon Street	5/28/2009
82	John Wolfe House*	905 West Cheyenne Road	1/23/2013
83	YWCA Building/Colorado Springs Company*	130 East Kiowa Street	9/10/1979

Source: Directory of Colorado State Register Properties, http://www.historycolorado.org/oahp/el-paso-county#colorado
*On both the Colorado State Register of Historic Properties and the National Register of Historic Places.

Other Cultural Resources in Colorado Springs and Vicinity[45]

- Cheyenne Mountain Zoo
- The Broadmoor Hotel
- The Flying W Ranch
- Garden of the Gods Park
- U.S. Olympic Complex
- U.S. Air Force Academy
- Pro Rodeo Hall of Fame
- Will Rogers Shrine of the Sun
- Colorado Springs Fine Arts Center
- Ghost Town Museum
- Western Museum of Mining and Industry
- Seven Falls

Penrose Fountain at America the Beautiful Park. Source: Jules Vigil

[45] Yahoo Travel Site, online at http://travel.yahoo.com/p-travelguide-2816507-colorado_springs_things_to_do-i, accessed on January 29, 2010

- Sertich Ice Center
- Penrose Fountain at America the Beautiful Park[46]

Economic Assets

Economic assets at risk may include major employers or primary economic sectors, such as, retail trade or health care, whose losses or inoperability would have severe impacts on the community and its ability to recover from disaster. After a disaster, economic vitality is the engine that drives recovery. Every community has a specific set of economic drivers, which are important to understand when planning ahead to reduce disaster impacts to the economy. When major employers are unable to return to normal operations, impacts ripple throughout the community. Table 4-62 lists the top employers in Colorado Springs, both private and public sector.

Table 4-62: Top Employers in Colorado Springs

Top 20 Private Sector Employers	Top 20 Public Sector Employers
Lockheed Martin Corporation	Fort Carson
Progressive Insurance Company	Peterson Air Force Base
Security Service Federal Credit Union	Schriever Air Force Base
United Services Automobile Association	United States Air Force Academy
The Broadmoor Hotel	School District #11 – Colorado Springs
Atmel Corporation	School District #20 – Air Academy
Verizon Business	Memorial Hospital-UCHealth
Northrop Grumman Corporation	Penrose-St. Francis Health Services
Hewlett Packard	City of Colorado Springs
Compassion International	El Paso County
T. Rowe Price Associates, Inc.	CSU
Comcast	School District #49 – Falcon
DePuy Synthes Companies of Johnson & Johnson	School District #2 – Harrison
Wells Fargo	University of Colorado-Colorado Springs
Time Warner Cable	Beth-El College of Nursing
Colorado Springs Health Partners	School District #3 – Widefield
Alorica	Pikes Peak Community College
Oracle America, Inc.	School District #8 – Fountain/Fort Carson
Serco	School District #38 – Lewis Palmer
CenturyLink	School District #12 – Cheyenne Mountain

Source: Colorado Springs Regional Business Alliance: http://www.coloradospringsbusinessalliance.com/economic-development/business-climate/major-employers-20130417133725 /, accessed on September 29, 2015.

[46]Google image search, online at http://3.bp.blogspot.com/_KpJl5zaeXS8/SfW35XT27CI/AAAAAAAAD9E/cyrdmhF3zUo/s800/Penrose+Fountain+hdr+1.jpg accessed on January 29, 2010, photo by Jules Vigil.

Table 4-63 describes the labor force and employment/unemployment information for the Colorado Springs MSA from June 2015 data.

Table 4-63: Labor Force Statistics for the Colorado Springs MSA

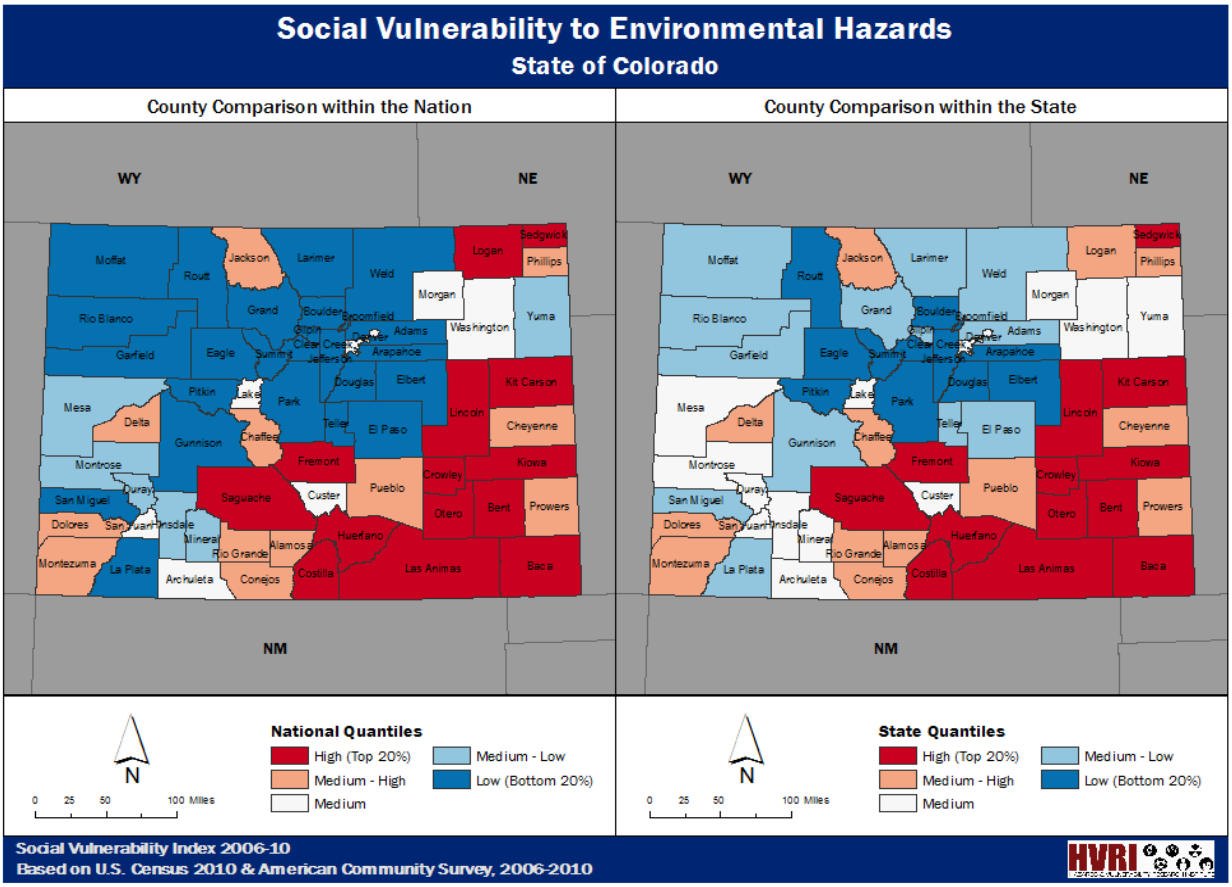
Area	Civilian Labor Force	Number Employed	Number Unemployed	Unemployment Rate
Colorado Springs MSA	315,072	298,620	16,452	5.2%
Colorado	2,829,024	2,706,185	122,839	4.3%

Source: State of Colorado Department of Labor and Employment, https://www.colmigateway.com/vosnet/lmi/area/areasummary.aspx?enc=SgfjA5gOXyjl8J88h1RJLecAxwGrSFJm1a/BOLe3+qqrPyS+jGFDSU8kiPjp8vIC, accessed on August 19, 2015.

Social Vulnerability

Certain demographic and housing characteristics affect overall vulnerability to hazards. These characteristics, such as age, race/ethnicity, income levels, gender, building quality, public infrastructure, all contribute to social vulnerability. A Social Vulnerability Index (SOVI) compiled by the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina measures the social vulnerability of U.S. counties to environmental hazards for the purpose of examining the differences in social vulnerability among counties. Based on national data sources, primarily the 2010 Census, it synthesizes 42 socioeconomic and built environment variables that research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. The updated SOVI based on 2010 Census is an update for this Plan. Eleven composite factors were identified that differentiate counties according to their relative level of social vulnerability: personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race (African American and Asian), ethnicity (Hispanic and Native American), occupation, and infrastructure dependence. Figure 4-82 illustrates Colorado counties compared to the state and national averages.

Figure 4-82: Social Vulnerability by County Compared with the State and Nation



Source: The Hazards and Vulnerability Research Institute, http://webra.cas.sc.edu/hvri/products/sovi2010_maps.aspx , accessed on June 10, 2015.

Compared to other counties in the nation and in Colorado, El Paso County's social vulnerability is low and medium-low, respectively. To better understand the characteristics behind this ranking, information from the 2010 Census on four factors of social vulnerability was researched: gender, age, language spoken in home, and poverty. One characteristic of social vulnerability is differential access to resources and greater susceptibility to hazards. All factors considered here are related to this characteristic. Table 4-64 displays these variables and compares them to the same variables for Colorado and the United States. These factors of social vulnerability hold many implications for disaster response and recovery and are important considerations when identifying and prioritizing mitigation actions and overall goals of the Plan.

Table 4-64: Social Vulnerability from 2010 U.S. Census

Jurisdiction	Total Population	Total Housing Units	% Female	% Under Age 18	% Age 65 and Over	% Speak Language Other than English in Home*	% Persons Below Poverty Level*
United States	308,745,538	133,957,180	50.8	23.1	14.5	20.7	15.4
Colorado	5,029,324	2,212,898	49.9	24.4	10.9	16.8	13.2
Colorado Springs	416,427	179,607	51.0	25.0	10.9	13.2	13.7

Source: 2010 Census, U.S. Census Bureau *Based on sample data. The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine the percentage of the population in poverty.

Age

Age can affect the ability of individuals to move out of harm's way and two variables for age were analyzed: percentage of population over 65, and percentage under age 18. At 25.0%, the percentage of Colorado Spring's population under 18 is slightly greater than Colorado as a whole, and the percentage over age 65 is equal to that of Colorado as a whole.

Language Spoken in Home

The language spoken in the home can signify language and cultural barriers that affect communication of warning information and access to post-disaster information. In Colorado Springs, 13.2% of the population speaks a language other than English in the home. This is below both the U.S. (20.7) and Colorado (16.8) percentages. The language spoken in the home is not likely to increase social vulnerability in the planning area but should still be considered by the City in regard to communication efforts.

Poverty

Wealth and poverty also are indicators of social vulnerability. Low income and impoverished populations have fewer resources available for recovery and are more likely to live in structures of greater physical vulnerability. Individuals and communities with greater wealth have more ability to absorb losses and be resilient in the face of disaster due to factors such as insurance and social safety nets. They also have greater capabilities to mitigate hazards and greater access to funds for recovery.

To compare wealth and poverty, the percentage of individuals below the poverty level in Colorado Springs was analyzed. Overall, Colorado Spring's percentage of individuals living below the poverty level (13.7) is lower than that of the nation (15.4) but slightly higher than Colorado (13.2).

4.10 Land Use and Development Trends

This section provides a general description of land use and development trends within the City of Colorado Springs and includes data on growth in population and housing units. The 2005 and 2010 Plans described that future growth (greenfield development) would primarily occur to the north and northeast because of a combination of vacant land, approved plans, and fewer topographic constraints. This is still true in 2016, including the North Powers Boulevard Corridor (Highway 21) from a few miles south of East Woodmen Road to Interquest Parkway/Highway 83 near its intersection with I-25. There has not been as much greenfield development activity west of I-25. The 2016 Plan expands on that concept by including demographic data projections and identifying key redevelopment areas through urban renewal.

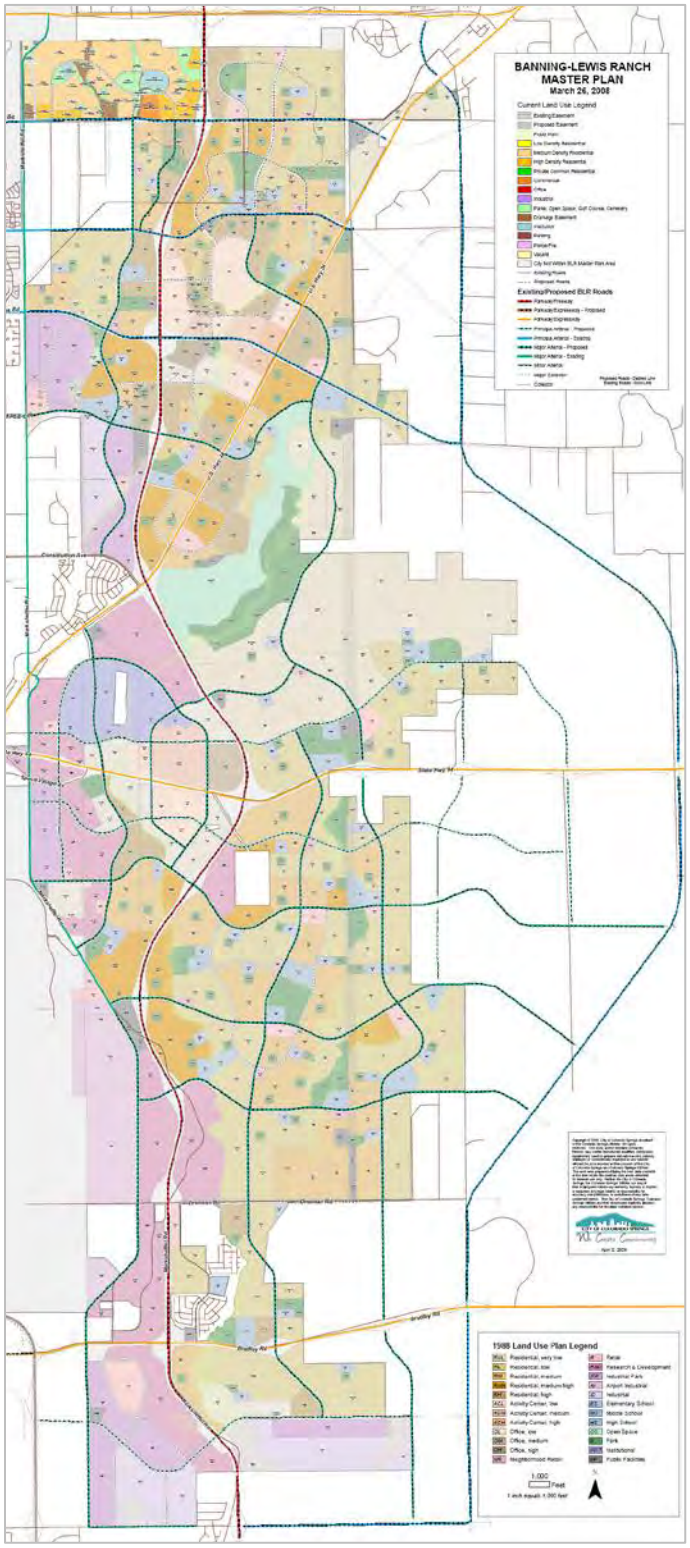
The long-term growth potential for the City will be primarily to the east of current development in the rolling plains. The Banning Lewis Ranch development contains approximately 24,500 acres which will accommodate considerable long-term growth. Banning Lewis Ranch, generally south of East Woodmen Drive and east of Marksheffel Road, comprises approximately 60% of Colorado Springs' new development capacity assuming the ceilings and zoning in the currently approved (as of 2015) Master Plan remain the same. This area has been master planned since 1988 and development is currently starting along the northern portion of the ranch property. Figure 4-83 illustrates the proposed land uses for Banning Lewis Ranch. The JL Ranch property, located in the southwest portion of the City, is one of the last remaining large parcels on the west side of the City yet to develop which has considerable hillside characteristics. It is anticipated that this property will develop once the economy improves.

Infill and redevelopment is anticipated to continue citywide. Several large parcels exist in various areas of the City that have considerable vacant acreage associated with them. Development of these parcels is expected within the near to mid-term. Redevelopment pressures will continue within older areas of the city. Areas within the downtown and the along the Nevada Avenue corridor have and are experiencing pressures for redevelopment. Figure 4-84 identifies the existing urban renewal areas within the city. These areas may potentially increase the total vulnerability of the city to natural hazards, as redevelopment often brings higher densities.

The general areas of growth in Colorado Springs that occurred from 2010 to 2015 are in the rolling plains and adjacent to the unincorporated areas of El Paso County that experienced the Black Forest Fire of 2013. These areas of new development would be vulnerable to five hazards identified in this plan but mostly likely to wildfire and severe weather.

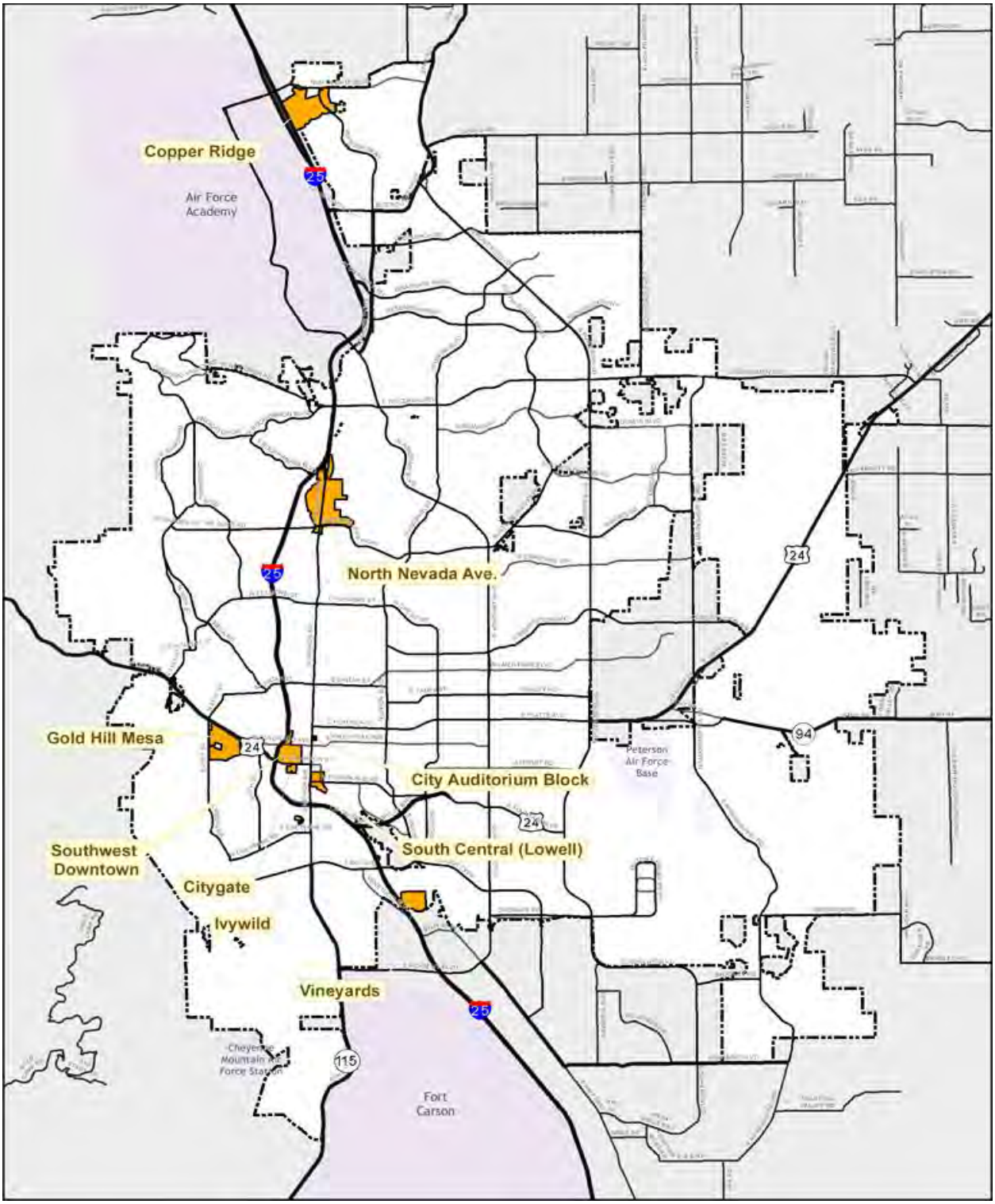
Figure 4-85 shows the 2020 Land Use Map which was updated in 2014.

Figure 4-83: Banning Lewis Ranch Master Plan Map



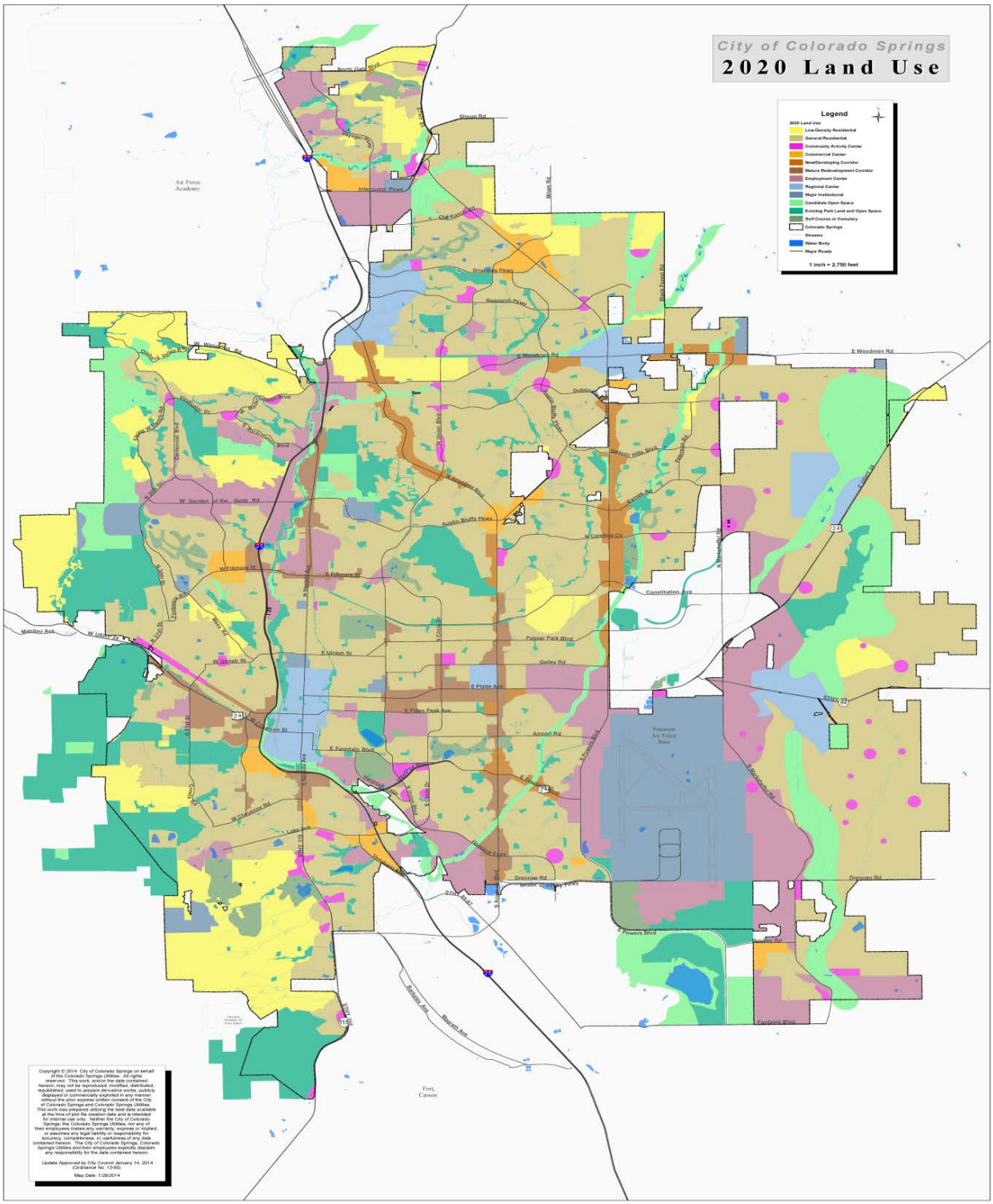
Source: Colorado Springs Map Gallery, www.springsgov.com, accessed on January 26, 2010.[still effective in 2016]

Figure 4-84: Urban Renewal Areas in Colorado Springs, 2015



Source: City of Colorado Springs Urban Renewal Authority, http://www.csurbanrenewal.org/csuraprojectmap.html#nil, accessed on August 27, 2015.

Figure 4-85: City of Colorado Springs Land Use 2020



Source: City of Colorado Springs, https://coloradosprings.gov/sites/default/files/planning/2020landusejan2014.pdf, accessed on August 27, 2015.

Table 4-65, Table 4-66, and Table 4-67 provide information on growth in population and housing units for the City of Colorado Springs and El Paso County. Table 4-68 provides population projections for Colorado Springs in 5-year increments to the year 2035.

Table 4-65: Population Growth in Colorado Springs, 2007-2013

Jurisdiction	2007	2013	Percent Change (%)
City of Colorado Springs	394,177	437,879	11.1
El Paso County	587,590	655,812	11.6

Source: Colorado Department of Local Affairs State Demography Office Section, http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251590805419/. 2015

Table 4-66: Growth in Housing Units in Colorado Springs, 2007-2013

Jurisdiction	2007	2013	Percent Change (%)
City of Colorado Springs	175,731	182,998	4.1
El Paso County	246,074	258,776	5.2

Source: Colorado Department of Local Affairs State Demography Office, http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251590805419/. 2015

Table 4-67: Population and Housing Unit Density in Colorado Springs, 2010-2014

Jurisdiction	Area in Square Miles	2010 Population Density* (per sq. mile)	2014 Population Density* (per sq. mile)	2010 Housing Unit Density* (per sq. mile)	2014 Housing Unit Density* (per sq. mile)
City of Colorado Springs	195	2,136	2,286	921	n/a
El Paso County	2,127	293	312	n/a	123

*Densities rounded to the nearest integer.
Sources: Colorado Department of Local Affairs Demography Section, www.dola.colorado.gov/dlg/demog/; and U.S. Census Bureau, www.census.gov/. 2010. Data reviewed for 2016 plan.

Table 4-68: Population Projections for El Paso County, 2005-2035

	2005	2010	2015	2020	2025	2030	2035
Population	569,322	627,232	674,630	727,807	786,295	845,985	905,014
Percent Change (%)	--	2.0	1.5	1.5	1.6	1.5	1.4

Source: Colorado Department of Local Affairs Demography Section, https://www.colorado.gov/pacific/dola/node/104466, https://drive.google.com/file/d/0B-vz6H4k4SESV1NLOHZCVXoyVm8/view?pref=2&pli=1, February 2016.

As indicated in Table 4-65, population growth rates from 2007 to 2013 in the unincorporated portions of El Paso County were slightly more than within the City of Colorado Springs. The population density in Colorado Springs was estimated at 2,286 per square mile in 2014, more than seven times that of the unincorporated parts of El Paso County. It can be generally stated that should major natural hazards hit the area, the impacted population would typically be greater in the City of Colorado Springs than unincorporated El Paso County. The State Demographers Office projects that the El Paso County population will rise to just over 905,000 by the year 2035, surpassing any other county in Colorado.

5. Capability Assessment

A community's regulatory, administrative, technical, and financial capabilities are directly related to the ability for that community to mitigate natural hazards prior to a major event taking place. For instance, a city with a full professional staff of geologic engineers will be well-equipped to provide protection and advice for landslide-prone properties. Conversely, a city without building codes may not have the leverage necessary to protect the welfare of individuals and property during a major wind event. Following is a list of the City of Colorado Springs' capabilities that foster hazard mitigation in one way or another.

5.1 Regulatory Mitigation Capabilities

Table 5-1: Regulatory Mitigation Capabilities

Capability	Available?
Master or Comprehensive Plan	YES
Emergency Operations Plan	YES
Economic Development Plan	YES
Capital Improvements Plan	YES
Community Wildfire Protection Plan	YES
Wildfire Mitigation Unit with Neighborhood Chipping Program	YES
Building Code	YES
Building Code Year	2003
Floodplain Ordinance	YES
Zoning Ordinance	YES
Subdivision Ordinance	YES
Water Shortage Ordinance (for drought)	YES
Stormwater Ordinance	YES
Growth Management Ordinance	Boundary
Site Plan Review Requirements	YES
Erosion/Sediment Control Program	YES
Stormwater Management Program	YES
National Flood Insurance Program Participant	YES
Community Rating System Participant	YES

Several policies and procedures from Colorado Springs' existing regulations, plans, and studies are related to natural hazard mitigation. Table 5-2 through Table 5-6 summarize those policies.

Table 5-2: City of Colorado Springs Comprehensive Plan Policies, Strategies, and Objectives

7.1.104 Areas of Consideration – Comprehensive Plan Procedures
B. Existing natural conditions shall be used to the extent possible in determining the type, density and intensity of public and private development of land within the planning jurisdiction of the City.
Chapter 1 – Land Use
Strategy LU 102g: Pursue Opportunities for Joint Funding of Regional Multi-use Facilities Pursue opportunities with other local government entities for joint funding of regional multi-use facilities such as parks, open space, drainage ways, and transportation corridors, and joint school/community facilities.
Objective LU 2: Develop A Land Use Pattern That Preserves the City's Natural Environment, Livability, And Sense of Community A focused pattern of development makes more efficient use of land and natural and financial resources than scattered, "leap frog" development. In contrast to dispersed patterns of development, a consolidated pattern helps to decrease traffic congestion and facilitates the ability of the City to provide needed services and public facilities, such as street maintenance, public transit, police and fire protection, and emergency services.
Policy LU 202: Make Natural and Scenic Areas and Greenways an Integral Part of the Land Use Pattern Treat the City's significant natural features, scenic areas, trail corridors, and greenways as critically important land uses and infrastructure that represent major public and private investments and are an integral part of the city and its land use pattern.
Strategy LU 202a: Use Natural and Scenic Areas and Greenways to Frame the Development Pattern of the City Utilize the 2020 Land Use Map, the Open Space Plan, Master Plans, and site-specific land suitability analyses to weave natural areas and greenways into a citywide open space system that frames the overall development pattern of the city.
Strategy LU 502d: Plan Residential Areas to Conserve Natural Features Plan neighborhoods in areas that contain significant natural features and environmental constraints to conserve those features through lower average densities or clustering of development.
Chapter 4 – Community Infrastructure/Services
Strategy CIS 101b: Prioritize Capital Improvements through SCIP and Strategic Planning Capital improvement projects will be prioritized as follows: First Priority: urgent projects that cannot reasonably be postponed, including, but not limited to maintenance, upgrading, or new construction projects which are needed to protect public health, safety and welfare (SCIP).
Objective CIS 4: Protect Drainageways An important element of the City's public safety and quality of life is the system of drainageways. A major concern is that the public safety and quality of drainageways need to be maintained or improved as adjacent areas are developed. There is a need to protect the drainageways as amenities and a significant natural resource for people and wildlife, in addition to their public safety aspects.
Policy CIS 401: Plan and Construct Drainageways as Amenities Plan and construct drainageways as amenities to the City by incorporating a comprehensive system of detention ponds in conjunction with "soft linings" or natural drainageways as the preferred method of treatment whenever possible.
Strategy CIS 401a: Use Master Drainage Basin Planning Studies Utilize the Drainage Basin Planning Studies to establish the method of drainage treatment for each specific basin and to determine the new development responsibilities for drainage facilities. Ensure adequate City funding to update these studies on a periodic basis.
Strategy CIS 401b: Drainage Ways Will be Planned as Urban Trail Corridors When possible, plan drainageways as urban trail corridors for multiple uses including conveyance of runoff, utilities, access roads, trails, wetlands, wildlife, trees, vegetation and recreational uses.

Chapter 5 – Natural Environment
Policy NE 201: Identify, Evaluate and Incorporate Significant Natural Features Preserve the variety of spectacular natural features, so prevalent in and around the City, for the enjoyment of residents and visitors. Incorporate significant natural features on individual sites into the design of new development and redevelopment. Identify and inventory natural features through Best Management Practices (BMPs) prior to incorporating features into site planning. Include significant natural features that contribute to the attractiveness of the community such as ridgelines, bluffs, rock outcroppings, view corridors, foothills, mountain backdrop, urban forest, floodplains, natural water bodies, clean air, natural drainageways and wildlife habitats.
Strategy NE 202b: Collaborate on Watershed Management Develop a comprehensive watershed management program for all watersheds in conjunction with other regional jurisdictions.
Strategy NE 202c: Drainage Way Protection Protect riparian areas and natural water bodies on public and private lands as natural drainage ways and ecosystems through land use plans, development plans, BMPs and ordinances. Update Drainage Basin Planning Studies and the development review process to require mitigation plans for development or modifications to existing utilities on lands with natural drainage ways.
Strategy NE 202d: Natural Ecosystem and Drainage Way Restoration Promote the restoration of significant natural ecosystems, habitats for native plant and animal species, natural water bodies and drainageways on public lands and require protection and mitigation plans for private lands during the development review process.
Policy NE 203: Manage and Enhance the Urban Forest Manage the city's urban forest to ensure an abundance of healthy and attractive trees, including parklands and street trees. Recognize that the diversity of tree species provides many benefits, including improving air quality, reducing noise levels, providing wildlife habitat, and adding to the aesthetics and overall quality of life in the community. Preserve, promote, and enlarge the urban forest to enhance air quality, wildlife habitat, and community aesthetics and overall quality of life; abate noise; and reduce flood damage. Manage potential fuel problems and development practices to reduce forest fire risk.
Strategy NE 203a: Enhance Community Awareness Enhance community awareness about the importance of the urban forest and the positive impact trees have upon the environment. Develop a Wildfire Management Program to address impacts of the wildland/urban interface.
Strategy NE 203b: Public Landscaping Preserve and protect trees and other landscaping on public property. Provide adequate funding to assure safe, well-maintained and healthy trees and shrubs on public property. Do not allow landscaping to obscure traffic signs or signals.
Strategy NE 204a: Monitor the City's Hillside Ordinance Monitor the provisions of the Hillside Ordinance to protect the environmental conditions of hillside areas and adjust such provisions as appropriate so that the hillsides and ridgelines are protected.
Objective NE 3: Minimize Environmental Hazards and Constraints Take into account natural and man-made hazards and the appropriate relationship between the natural and built environment in all planning, policy, and development decisions. Minimize impacts from natural and man-made hazards to protect citizens, property, and the environment. The city, county, and other appropriate governmental agencies will cooperatively develop plans, programs, regulations, and incentives to reduce the impacts from natural and man-made hazards.
Policy NE 301: Develop Plans and Regulations Develop plans and regulations to protect environmental quality and important ecological functions and minimize hazards to health and property through development reviews and implementation of plans and ordinances addressing environmental hazards and constraints.
Strategy NE 301a: Refine Plans and Regulations Continually refine plans and regulations to address floodplains, streams/drainageways, hillsides and geologic hazards and ensure consistency between these planning and implementation tools.

Strategy NE 301b: Master Plans to be Consistent with Drainage Basin Plans Ensure that all individual master plans are consistent with the Drainage Basin Planning Studies. Update existing master plans as development review is requested. Foster cooperation between the city and property owners to ensure that individual master plans are consistent with the Drainage Basin Planning Studies and the Comprehensive Plan policies and land use maps or require an amendment to these City Plans.
Strategy NE 301c: Carefully Site Infrastructure in Hazard and Constrained Areas Recognize and avoid, whenever possible, geologic hazard and constrained areas in the placement of infrastructure. If this is not possible, siting of facilities and necessary access will minimize their impact and maximize restoration of disturbed areas. Revise subdivision and development standards to provide greater flexibility in the placement of infrastructure in and around environmentally sensitive areas. Include a protection and mitigation plan in all proposals for development on sites containing geologic hazards and constrained areas.
Strategy NE 301d: Mitigate Identified Hazards Develop and use mitigation plans to minimize risk to life and property by structural and non-structural design or modification of actions. Use mitigation plans where it is not otherwise practical to place structures or human activities outside of these hazard areas. Discourage new development in delineated hazard areas.
Policy NE 302: Protect Drainageway and Floodplains Limit development of land within floodplains, which should remain, or be returned, to its natural state. Development can reduce a floodplain's ability to store and convey water, intensifying velocity and depth of floodwater in other areas. Areas subject to significant flooding also pose a threat to citizens and property. Floodplains are lands identified in the Streamside Overlay Zone and FEMA designations.
Strategy NE 302a: Use Drainage Basin Planning Studies for Stormwater Management Use the established method of drainage treatment for a particular Drainage Basin Planning Study for all proposed development or redevelopment, or require an amendment to the Study if changes are proposed or required. Use BMPs to address erosion, sediment control and stormwater quality during construction and after development. Minimize the adverse impacts of stormwater runoff, including erosion/sedimentation, to drainageways and other drainage facilities. Plan and utilize floodplains and drainageways as greenways for multiple uses including conveyance of runoff, wetlands, habitat, trails, recreational uses, utilities and access roads when feasible, considering the primary intended use.
Strategy NE 302b: Retain Floodplains in their Natural State. Floodplains will remain as undisturbed riparian corridors, wildlife habitat, or wetlands whenever possible. Trails or other open recreational facilities and utility facilities such as electric, gas, and water mains may be appropriate in certain areas. Identify these areas in master plans, development plans and development proposals.
Strategy NE 302c: Flood Damaged Property Will not be Permitted to Rebuild Compliance with FEMA requirements is required for all properties within high flood hazard areas. Any structural rebuilding must minimize the potential for sustaining future damage. Do not grant a building permit for expansion to properties prone to damage by flooding. Prepare a plan for property acquisition of flood-damaged property and undevelopable land in high flood hazard areas. Permit rebuilding or expansion as appropriate only for necessary utility infrastructure such as electric, gas, and water mains or other public infrastructure.
Policy NE 303: Avoid or Mitigate Effects of Geologic Hazards Undertake efforts through the development review process to substantially reduce adverse consequences of development by recognizing and appropriately addressing geologic processes. Discourage development in potentially hazardous areas associated with hillside and geologic development constraints, including steep slopes, erosion, unstable soil, subsidence, coal hazards or similar development constraints.
Strategy NE 303a: Identify Geologic Hazards Carefully delineate geologic and coal hazards and determine appropriate locations for development through the development review process.
Strategy NE 303b: Monitor the City's Geologic Hazard Ordinance Monitor the provisions of the Geologic Hazard Ordinance to protect the environmental conditions within geologic hazard areas and adjust them as appropriate so those geologic hazards are mitigated.

Policy NE 402: Water Conservation Encourage water conservation in both the public and private sector through information and educational services, financial incentive programs, and requirements and incentives in the planning process.
Strategy NE 402a: Utilize Water Conservation Regulations Utilize adopted landscaping standards requiring water-conservation irrigation and use of drought-tolerant plants for new commercial and multi-family developments. Establish minimum water conservation standards for landscape and irrigation systems for all development subject to City landscape plan review and approval.
Strategy NE 402b: Expand Opportunities Non-potable Water Use Work with the Colorado Department of Public Health and Environment, Colorado Springs Utilities, and other government entities and developers to develop opportunities for use of non-potable water. Include self-designed water reuse for consumers of large quantities of water in development plans. Consider non-potable water for large non-residential consumptive uses that do not require potable water. Examples include, but are not limited to, golf courses and public facilities, such as city parks.

Table 5-3: Subdivision Regulations related to Natural Hazard Mitigation

7.3.504: HILLSIDE AREA OVERLAY ZONE:
2. Purpose: The purpose of the hillside area overlay or HS is to specify conditions for any type of development to ensure that these areas retain their unique characteristics, to safeguard the natural heritage of the City, and to protect the public health, welfare and safety. It is the intent of these regulations to ensure that development within this overlay zone is compatible with, and complements the natural environment as well as to minimize physical damage to public and private property. (The City has developed Vegetation Management Guidelines as well as an Ignition Resistant Construction Design Manual that was developed in the aftermath of the Waldo Canyon Fire. In 1996, the City prepared a Hillside Development Guidelines Manual.)
APPENDIX K: WILDLAND URBAN INTERFACE MITIGATION REQUIREMENTS FOR THE HILLSIDE AREA OVERLAY ZONE (also referred to as City Ordinance No. 12-111 passed on 12/5/12):
K101.1 Scope. Wildfire Mitigation: Wildfire risk reduction techniques shall include monitored smoke alarm systems, sprinkler systems, fire resistant roofing materials which are class A (excluding solid wood roofing products) for all residential occupancies, a minimum class B on all other occupancies, fire resistive construction materials, and fuels management measures. Within the Hillside Overlay Zone, fuels management measures shall be utilized within the safety zone of applicable new building construction. "Fuels management" is defined as the modification of landscaping and ornamental vegetation within the safety zone. Fuels management requirements, as set forth below, are intended to protect structures from wildfire as well as to reduce fire from spreading to the wildland. The "safety zone" is defined as the area within thirty feet (30') of the main structure or significant accessory structures, not to extend beyond the property line. As it is the City's desire to provide an environment safe from wildfire while maintaining the aesthetic qualities of the native hillside, the following wildfire risk reduction standards shall be required for all new building construction or reconstruction in the Hillside Overlay Zone, regardless of development plan approval date or initial construction plan approval, unless specifically exempted within this ordinance, and in accord with Section 7.3.504 of the Code of the City of Colorado Springs, as amended. Nothing in this ordinance herein is intended to be retroactive to existing homes not under the provisions of the Hillside Ordinance at the time of original construction.
7.7.609: HILLSIDE DEVELOPMENT:
A monitored smoke alarm system or a sprinkler system shall be required for all new homes on lots with lot lines that are more than one thousand feet (1,000') from the entrance of a cul-de-sac or lie on or beyond roadways with grades in excess of 10%, if those roadways are the only points of vehicular access. These lots shall be identified on the subdivision plat. This requirement shall not apply to subdivision plats recorded prior to March 24, 1981, or to subdivisions for which a development plan was approved prior to April 1, 1993. (Ord. 96-44; Ord. 01-42)

7.7.901: PURPOSE: (Part 9 Subdivision Drainage Facilities)
A. The City Council hereby finds, determines and declares the urgent necessity of providing storm drains and other facilities for the drainage and control of flood and surface waters including facilities or best management practices (BMPs) to control stormwater quality within areas and territories to be subdivided and developed and the City Council further finds and declares that the facilities are required for the proper and orderly development of the areas and territories in order that storm and surface waters may be properly drained and controlled along with stormwater quality and that the health, property, safety and welfare of the City and its citizens may be safeguarded and protected.

Table 5-4: Zoning Code Regulations related to Natural Hazard Mitigation

Article 4: Site Development Standards

Part 5 – Geologic Hazards Study and Mitigation

7.4.501: PURPOSE: The purpose of this part is to identify geologic conditions, which may pose hazards to a land development project in order that appropriate mitigation or avoidance techniques may be implemented. The types of geologic hazards to be identified shall include, but not be limited to, the following: A. Expansive soils and expansive rock; B. Unstable or potentially unstable slopes; C. Landslide areas or potential landslide areas; D. Debris fans; E. Rockfall; F. Subsidence; G. Shallow water tables; H. Springs; I. Flood prone areas; J. Collapsing soils; K. Faults; and L. Dipping bedrock. (Ord. 96-74; Ord. 01-42)

Chapter – Article 3 – Part 5: OVERLAY DISTRICTS

7.3.501: PURPOSE: The purposes of this part are to provide a method for applying additional standards and conditions to base zone districts when necessary to ensure compatibility with adjacent land uses, increase design flexibility, protect surrounding areas from negative impacts of new development proposals, preserve outstanding elements of the City's heritage, prevent destruction of the natural and topographic character of hillside areas, prevent loss of life and minimize damage to properties located in or near areas of flood hazard areas, allow development of high rise areas, and promote the public health, safety, and general welfare. The overlay districts are:

DFOZ	Design flexibility overlay
HR	High rise overlay
HS	Hillside area overlay
HP	Historic preservation overlay
AO	Airport overlay
P	Planned provisional overlay
SS	Streamside overlay zone

(Ord. 94-107; Ord. 01-42; Ord. 02-166; Ord. 06-89; Ord. 09-70)

Chapter 7 – Article 8: Floodplain Management

7.8.101: FLOODPLAIN MANAGEMENT: Floodplain management within the City shall be in accordance with section RBC 313 of the Building Code. (Ord. 96-44; Ord. 01-42; Ord. 05-135)

5.2 Administrative and Technical Capabilities

Table 5-5: Administrative and Technical Capabilities

Administrative/ Technical Resources	Available?
Planner/Engineer with knowledge of land development practices	YES
Engineer/Professional trained in construction practices related to buildings/ infrastructure	YES
Planner/Engineer/Scientists with understanding of natural hazards	YES
GIS capabilities	YES
Full-time building official	YES
Floodplain Administrator/CRS Coordinator	YES
Emergency Manager	YES
Wildfire Mitigation Staff and Program	YES
Staff to conduct Flood Preparedness Meetings and Wildfire Evacuation Drills	YES
Grant Writer	YES
Warning Systems/Services	YES

5.3 Fiscal Mitigation Capabilities

Table 5-6: Fiscal Mitigation Capabilities

Financial Resources	Available?
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
Incur debt through special tax bonds	NO
Withhold spending in hazard-prone areas	NO

The State of Colorado has a tax credit for Colorado property owners who perform wildfire mitigation measures on their property (Income 65: Wildfire Mitigation Measures Subtraction). The tax credit is for up to $2,500 in wildfire mitigation measures annually. Details are available at https://www.colorado.gov/pacific/sites/default/files/Income65.pdf.

Colorado Springs Disaster Assistance Center, September 2013. Source: City of Colorado Springs.

5.4 Mitigation Outreach and Partnerships

The City of Colorado Springs is currently providing several public and private outreach programs aimed at natural hazard mitigation and risk reduction. Many of these programs were in place during the 2016 Plan.

Colorado Springs Flash Flood Education Program ("Ditch Playing in the Ditches"): Provides information on the danger of flash flooding. It provides several informative steps of what can be done before or during a flood event.

Community Wildfire Protection Plan, 2011: CSFD adopted the CWPP in 2011. The plan focuses on "Sharing the Responsibility." The plan will be updated in 2016.

Civil Military Emergency Management Collaborative: Colorado Springs coordinates and participates in the collaborative, which brings together emergency managers from all the military installations near the City and from a variety of other organizations.

Water Conservation Plan: CSU adopted the Water Conservation Plan 2008-2012 which outlines future needs assessment and conservation strategies.

Vulnerable Populations Analysis, 2010: The City of Colorado Springs OEM drafted a vulnerable population's needs assessment in 2010. Subsequently, the City hired a full-time American's with Disabilities Act coordination. OEM also co-chairs the regional Access and Functional Needs working group with the Independence Center.

Xeriscape Educational Program: CSU actively educates the public on xeriscaping in the dry climate in which we live. There are both online and classroom opportunities.

Silver Key Senior Services: Silver Key provides nutritional, transportation, and independent living services to the elderly population in the City of Colorado Springs. In the event of a natural hazard event, their services are crucial.

StormReady Community: The City of Colorado Springs is recognized as a StormReady Community by the National Weather Service. This program encourages the proactive planning for major weather events and improving hazardous weather operations.

FireWise: The CSFD provides an online resource for citizens to understand their individual risk to wildfire, and provides information on reducing the risks to property damage associated with wildfire.

Community Services Section – CSFD: The Community Services Section of the CSFD is dedicated to education efforts to ensure a safe community including life safety programs and business community outreach, among others.

Additional Emergency Management Outreach: OEM undertook several collaboration efforts in 2014 including:

- Emergency Management Access and Functional Needs Working Group
- Emergency Management Collaborative
- Public-Private Partnerships
- Waldo Canyon Regional Recovery Working Group
- South Central All-Hazards Region
- South Central Region Voluntary Organizations Active in Disasters
- Special Events Planning[47]

Pikes Peak Wildfire Prevention Partners: The PPWPP is a not-for-profit interagency task force committed to the prevention and mitigation of wildland fires. PPWPP's mission is to provide effective reduction of the threat of wildfire to life and property in El Paso, Teller and Douglas counties.[48]

El Paso County Conservation District: The District offers plant and soil advice, promoting conservation activities throughout Colorado Springs and surrounding communities.

Colorado Springs Together: Colorado Springs Together is a community-driven volunteer effort, and is an independent 501(c)(3) non-profit organization. Its purpose is to disseminate information, resources, and assistance to the community affected by the Waldo Canyon Fire throughout the recovery process. Colorado Springs Together disbanded their efforts in 2013. All future advocacy in the area is being provided by the Mountain Shadows Community Association (http://www.mscaweb.com/).

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[47] The City of Colorado Springs Office of Emergency Management 2014 Annual Report, https://oem.coloradosprings.gov/public-safety/emergency-management/plans-reports-guides-forms/2014-oem-annual-report, accessed on August 27, 2015.

[48] Colorado State Hazard Mitigation Plan, page 82.

Black Forest Together, Inc.: Black Forest Together was formed by Black Forest citizens to help the community recover from the catastrophic Black Forest Fire of June 2013. Black Forest Together, Inc. is an approved tax-exempt 501(c)3 charitable organization. Its mission is to help the people of the Black Forest region to recover, rebuild and restore their lives, protect the Forest's water quality and ecological health with an emphasis placed on community values, economic stability and the richness of the natural environment today and in the future.

Plans are listed in Section 3.2, Element A, Step 3.

6. Mitigation Strategy

FEMA Requirement

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

EMAP Standard (2013)

Standard 4.4.1: The Emergency Management Program shall develop and implement its mitigation program to eliminate hazards or mitigate the effects of hazards that cannot be reasonably prevented. The mitigation program identifies ongoing opportunities and tracks repetitive loss. The Emergency Management Program implements mitigation projects according to a plan that sets priorities based upon loss reduction.

This chapter describes the revised mitigation strategy developed by the LPC based on the risk assessment detailed in Chapter 4.

6.1 2016 Plan

The LPC reviewed and revised the 2010 mitigation strategy made up of goals and actions through a collaborative group process at its meetings. The 2016 mitigation strategy consists of the overall strategy statements, goals, objectives, and mitigation actions.

- **Strategy Statements** are statements that define the plan's purpose for existence and primary function. These were taken directly from the original 2005 PDM Plan, and are described in section 5.1.
- **Goals** are general guidelines that explain what the plan means to achieve. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. They are meant to be achieved over the long term and typically consist of broad, policy statements.
- **Objectives** are standards that can be reasonably achieved within a certain timeframe.
- **Mitigation Actions** are specific actions designed for implementation that help achieve the goal and objectives. The LPC reworded some actions, continued some, eliminated others, and developed new actions for the 2016 Plan.

6.2 Plan Strategy Statements, Goals, and Objectives

FEMA Requirement

44 CFR Requirement §201.6(c)(3)(i): [The mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The original 2005 Plan strategy statements were retained for the 2016 Plan with a few revisions to include human-caused hazards. They are as follows:

- Natural disasters are inherent to the geographic area and human-caused hazards have the potential to occur due to the level and type of development and activities in the area. Disasters will continue to occur and affect people, businesses, government functions, and other community activities, functions and processes.
- Pro-active comprehensive preparedness and mitigation programs involving city entities, in partnership with other agencies, other partners, and the public is in the best interest of the community to reduce the effects of a disaster as well as reducing the time and resources required for response and recovery.
- The long-term strategy and vision for the City is to sustain successful measures that reduce exposure to future disaster losses and implement other measures that strengthen the disaster preparedness of the community.

After the second meeting on July 29, 2015, representatives from the LPC evaluated the previous plan goals and objectives and determined that with a few revisions, they were still valid for addressing the risk from hazards in Colorado Springs. These goals and objectives are supportive of the comprehensive range of mitigation action types needed to reduce vulnerability from hazards. These refined goals and objectives were presented to the LPC and stakeholders at the final meeting on September 10, 2015.

GOAL: Reduce or eliminate the exposure to property damage, injury or loss of life, and damage to the natural environment caused by hazards.

Objective A: Identify and initiate improvements to public safety, response, and recovery programs to reduce risk and vulnerability.

Objective B: Follow through with and leverage existing organizations, programs, and procedures to implement the Plan.

Objective C: Build upon existing public outreach efforts to reduce risk and vulnerability to hazards.

Objective D: Leverage financial assistance and other resources to strengthen the City's disaster resiliency.

Objective E: Continue to improve the regulatory review process for development and construction in the vicinity of known hazard areas.

Objective F: Continue to assess ongoing disaster preparedness programs that maintain or improve City preparedness.

6.3 Status of Previous Actions

During the 2016 planning process, the LPC provided a current status on progress for the actions from the 2010 Plan captured in Table 6-1.

Table 6-1: Status of Actions from 2010 Plan

Action # and Hazard	Mitigation Action Description	Responsible Agency	CURRENT STATUS
Objective A: Identify and initiate improvements to public safety, response, and recovery programs to reduce risk and vulnerability.			
A-1 All Hazards	Upgrade aging infrastructure such as transportation, drainage, utilities, and others that could be affected during a major natural disaster.	OEM and Engineering	Public Works is upgrading/replacing infrastructure elements as funding comes available. Last year (2014) the City spent over $5M repairing concrete channels below the Waldo Canyon burn scar. This is an on-going, continuous process into the future and will be part of on-going practices in the Plan Maintenance checklist.*
A-2 Flood	Evaluate repetitive loss properties and potential solutions to mitigate existing conditions.	OEM	As repetitive loss properties are identified, the process begins to mitigate the dangers. This is an on-going, continuous process into the future and will be part of on-going practices in the Plan Maintenance checklist.*
A-3 Flood	Update and maintain the Jimmy Camp Creek and Cottonwood Creek Drainage Basin Planning Studies.	Engineering	Jimmy Camp Creek Basin has been completed and adopted. Cottonwood has not. This action is closed out and will be carried on in the future in the form of updating the City Drainage Criteria Manual.
A-4 Flood, Dam & Levee Failure	Evaluate funding alternatives to achieve USACE certification of the Templeton Gap Floodway (levee).	Engineering	This has become a non-issue as the proposed changes were never done. This item has been removed and there is a new 2016 action addressing the levee.
Objective B: Follow through with and leverage existing organizations, programs, and procedures to implement the PDM Program.			
B-1 All Hazards	Continue to expand the capabilities and participation of the Emergency Management Committee and Volunteer Committee.	OEM	Expanded the Multi-Agency capabilities with formal structuring of the Civil-Military Emergency Management Collaborative. Expanded the use of volunteers utilizing the Community Advancing Public Safety (CAPS) program. This is an on-going, continuous process into the future and will be part of on-going practices in the Plan Maintenance checklist.*
B-2 All Hazards	Develop a strategy to integrate the PDM plan with the City's strategic plan and other long-term planning documents.	OEM/Planning	Planning continues to work with other agencies on long-range plans; where possible the PDM is integrated*

Action # and Hazard	Mitigation Action Description	Responsible Agency	CURRENT STATUS
B-3 Flood	Complete GIS and other automated inventories for stormwater, problem drainage areas, DFIRM and other City assets.	Engineering	The City Asset Management Team updates and maintains GIS maps and inventories for all civil infrastructure to include stormwater, problem drainage areas, and other City assets. DFIRM is maintained by FEMA on its website. Asset Management Team continues to update stormwater inventory for new systems and attribute refinements.*
B-4 Drought	Coordinate with CSU to review its current water conservation and drought programs.	CSU and OEM	CSU is developing an Integrated Water Resource Plan for 2015 that will address water conservation and drought as well as other critical water resource issues (see https://www.csu.org/Pages/iwrp-r.aspx).*
B-5 Flood	Achieve and maintain a Class 6 rating in the CRS for floodplain management.	PPRBD and OEM	A CRS Class 6 rating was achieved and maintained during the time of the 2016 Plan. Floodplain management is performed by Pikes Peak Regional Building Department.*
B-6 Dam & Levee Failure	Review the EAPs provided by CSU.	OEM and CSU	Copies of CSU EAPs are on-hand at OEM. OEM has reviewed and is familiar with them. OEM also developed a Rampart Dam Emergency Response Plan and Quail Lake Emergency Response plan.*
B-7 Dam & Levee Failure	Attend EAP exercises coordinated by CSU.	OEM and CSU	OEM attends EAP exercises as CSU hosts them. Also established the CSU/OEM Collaborative to strengthen planning and training.*
B-8 Wildfire	Continue to develop programs and allocate resources for the reduction of fuels in potential wildfire areas. This includes continuing the Wildfire Mitigation (WM) program as well as organizing and providing resources that can be used to reduce natural fuels.	WM-Division of FM	Completed /Ongoing. Obtained funding from corporate, state and private foundation grants. Fuels mitigation includes neighborhood chipping, residential stipends for defensible space and fuels treatments in parks, open spaces and common areas.*
B-9 Wildfire	Continue to develop partnerships with other organizations to implement wildfire mitigation plans and other hazard reduction programs.	WM-Division of FM	Completed/Ongoing. Work in stewardship with 110 neighborhoods/ HOAs. Work with state, county, federal and nonprofit agencies.*
B-10 Wildfire	Complete and maintain the CWPP including the assessment of parcels identified in the Wildland Urban Interface.	WM-Division of FM	Completed / Ongoing – completed and approved in 2011. Projects implemented. Revision slated for 2016.*

Action # and Hazard	Mitigation Action Description	Responsible Agency	CURRENT STATUS
B-11 Wildfire	Implement the actions identified in the CWPP.	WM-Division of FM	Ongoing. Projects implemented as grant funding allows. Waldo in 2012, Flood in 2015.* Actions since the Waldo Canyon Fire, such as additional wildfire protection requirements in the City code, show progress toward implementing the CWPP objectives.
B-12 Dam & Levee Failure	Work with the State Division of Water Resources to evaluate the dams that are not managed by CSU to determine high or significant impact and current conditions.	OEM	This is an on-going, continuous process into the future and will be part of on-going practices in the Plan Maintenance checklist.*
Objective C: Build upon existing public outreach efforts to reduce risk and vulnerability to natural hazards.			
C-1 All Hazards	Collaborate with other stakeholders (public, businesses, non-profit organizations, government and regulatory agencies, and others) for public outreach efforts.	OEM	Re-Invigorated the Colorado Emergency Preparedness Partnerships (CEPP) Program in 2015. Reaches out to wide array of partners for increased public outreach and collaboration.*
C-2 All Hazards	Restructure the public outreach strategy to share responsibilities amongst the citizens, federal, state, and local governments.	OEM	Published the 2015 OEM Emergency Public Relations Plan that formalizes OEM outreach and communications strategy. Both OEM and CSFD have conducted community outreach meetings since 2010 and OEM conducted a public survey during the 2016 planning process.*
C-3 All Hazards	Continue to operate the City's OEM natural hazards website.	OEM	The City's website has been maintained and upgraded with information on natural hazards.*.
C-4 Earthquake	Incorporate earthquakes in OEM's public outreach strategy.	OEM	Worked with local media and informed public of earthquake hazard. Public asked to rate hazards in recent public survey. New 2016 action will replace this one.
Objective D: Leverage external financial assistance and other resources to strengthen the City's disaster resiliency.			
D-1 All Hazards	Pursue additional grants to implement risk reduction projects.	OEM	OEM pursues grant funds as available to implement risk reduction projects. Much of the funding OEM has received has been as a result of Federal Disasters in 2012 and 2013. OEM will continue to pursue grant funding resulting from the 2015 flood declaration. Flood mitigation actions from 2012 onward in Appendix C.*
Objective E: Continue to improve the regulatory review process for development and construction in the vicinity of known natural hazard areas.			

Action # and Hazard	Mitigation Action Description	Responsible Agency	CURRENT STATUS
E-1 Landslide	Continue to involve the Colorado Geological Survey in land use reviews and hazard assessments.	Planning	On-going coordination with CGS continues for projects in high risk areas which include landslide, mining subsidence, expansive soils, and other geological hazards.*
Objective F: Continue to assess ongoing disaster preparedness programs that maintain or improve City preparedness.			
F-1 All Hazards	Maintain Emergency Management Accreditation Program certification.	OEM	Documentation is tracked and retained to assist in future reaccreditation.*
F-2 Flood, Wildfire,	Ensure the effectiveness of large-scale evacuation plans through full-scale tests.	OEM	Conducted several neighborhood evacuation full-scale drills from 2010 to 2015.*
F-3 All Hazards	Maintain the programs and data outlined in the Special Needs Assessment and Plan.	OEM	Established the Access and Functional Needs (AFN) Working Group to formally address AFN emergency preparedness issues and resolve problems.*
F-4 All Hazards	Develop preparedness guides for Colorado Springs residents and businesses.	OEM	A preparedness guide has been developed and is posted on the website and printed. Copies are provided at community events and citizen requests. Maintenance is on-going.*
F-5 All Hazards	Continue to improve the communication of severe weather warnings, flood warning, and related information.	OEM	Published the 2015 OEM Emergency Public Relations Plan that formalizes OEM outreach and communications strategy. Numerous instances of media outreach to include collaboration with NWS and local media to discuss communication strategies.*
F-6 Flood	Prepare a feasibility study on updating the City's rain gauge automation system to the Gauge-Adjusted Radar Rainfall (GARR) System.	OEM	This activity was found to be impractical. The cost was found to be very high as compared to the value of confirming what is already known. This item will be revised for the 2016 Plan.
F-7 All Hazards	Consider the use of a resource management system to capture the financial data for natural hazard events.	OEM	OEM has developed the resource management portion of WebEOC which tracks requests and costs. City finance has several mechanisms in place that track costs by event.*

*Keep as on-going practices and this is reflected in the Plan Maintenance Checklist

6.4 Other Actions Implemented Since 2010

As with all communities that have prepared HMPs, circumstances and events intervene and force the community to respond to them. As described throughout the Plan, the City of Colorado Springs has experienced several large-scale disaster events since 2010 that have warranted Presidential Disaster Declarations. As a result, OEM and the City have focused their efforts on responding to and recovering from these disasters. In doing so, they have also seized opportunities to rebuild better and implement mitigation.

The City and other recovery entities have conducted multiple post- Waldo Canyon Fire actions to stabilize and re-vegetate the burn scar as well as mitigating impacts of increased flooding in the watersheds downstream of the burn scar. In addition, the City revamped its fire mitigation requirements in response to the fire. The following are examples of these actions:

- BAER team dropped mulch on burn scar
- Log erosion barriers were placed on the burn scar
- Seeding to re-vegetate burn scar (see Table 6-1 for re-vegetation in burn scar)
- Glen Eyrie Channel Widening from capacity of 400 cfs to 2,000 cfs
- Installation of Queen's Canyon Debris Nets (upper and lower nets)
- Construction of Garden of the Gods Sediment Pond on Camp Creek
- Construction of Douglas Creek Sediment Pond
- City investment of $8.8 million in flash flood mitigation efforts related to the Waldo Canyon Fire to rebuild/restore the existing downstream concrete channels. In addition, $8.2 million in Natural Resources Conservation Services Emergency Watershed Protection Program funds to be used in the burn area for construction projects that will lessen the amount of debris entering downstream drainage facilities. This includes debris catchment facilities (large holes), debris fences, aerial mulching and seeding.
- Multiple public awareness meetings and enlisting public support in early identification of wildfires
- Addition of Appendix K to Hillside Overlay Zone Ordinance including required installation of monitored fire alarm system, internal sprinklers, restriction on roof materials, required fire restrictive construction materials and 30 foot safety zone which restricts the types of vegetation
- Preparation of an Ignition Resistant Construction Design Manual and a Vegetation Management Guide
- Preparation of Stormwater Needs Assessment Report (2013)

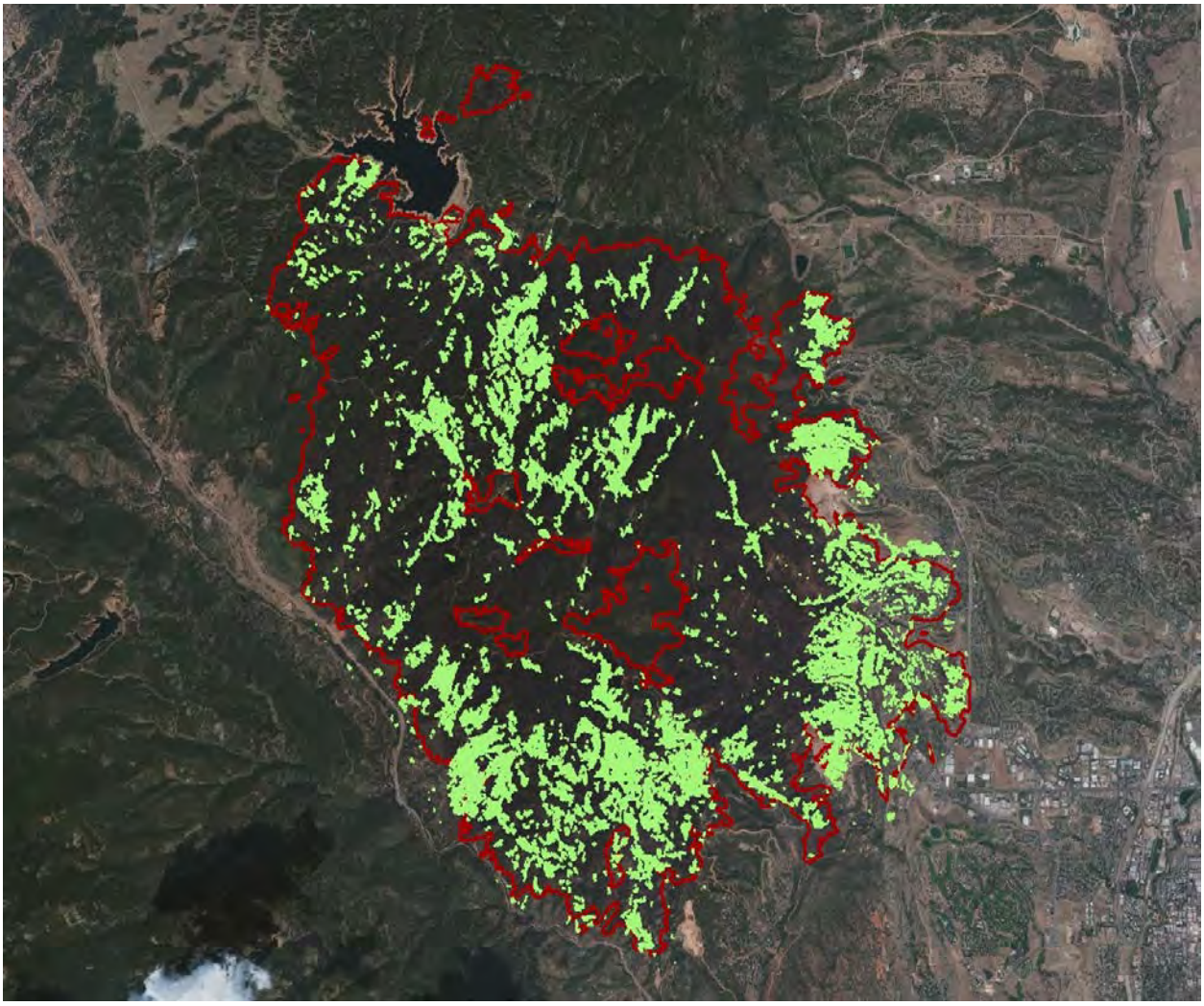
Flood mitigation along Camp Creek at Glen Eyrie, October 2014. Source: City of Colorado Springs

Flood mitigation along Camp Creek at Garden of the Gods Park, August 2015. Source: City of Colorado Springs

Sediment catchment basin post-Waldo Canyon Fire. Source: City of Colorado Springs

- Black Forest Together distributed 10,000 trees on May 9, 2015 to help re-vegetate the Black Forest burn scar area
- CSU in conducting its own Hazard Risk Assessment and Business Impact Analysis
- After the heavy rainfall in May/June 2015 that resulted in a Presidential Disaster Declaration, OEM sought Public Assistance Mitigation (Section 406) funds to rebuild infrastructure in a manner that it is at less risk from future disasters.
- Other Wildfire Actions
    - Overlay area: As city limits expand, newly incorporated land adjacent to the existing Hillside Area Overlay should be considered for addition to it
    - Mitigation: Continue stipend program in which wildfire mitigation grants are available to qualified property owners (see Colorado Springs CWPP for more information)
    - Treatments:
        - Continue thinning efforts within city limits
        - Beyond city limits, the Fire Department will conduct prescribed burns / slash-burn in watershed (city assets)
    - Education:
        - Continue business education and outreach efforts
        - Build volunteer corps
        - Continue collaborating with insurance companies to assist with enforcement of Hillside Area Overlay ordinance requirements

Figure 6-1: 2012 to 2014 Re-vegetation Efforts in the Waldo Canyon Burn Scar



Source: Colorado Springs OEM. 2012 Acres Burned: 18,247; 2013 Re-Vegetation: 1,086 Acres (6%); 2014 Re-Vegetation: 1,621 Acres (9%); Total Re-Vegetation: 2,707 Acres (15%). Multispectral satellite data analysis by U.S. Geological Survey, Special Applications Science Center, Denver, Colorado Vegetation analysis produced from © DigitalGlobe July 4, 2012 Worldview-2; September 25, 2013 Quickbird; and August 30, 2014 Worldview-2 multispectral imagery. The datasets were orthorectified using USGS 10-m NED DEM information to improve spatial accuracy. Multispectral satellite imagery from DigitalGlobe through the NextView contract with the U.S. Geological Survey.

6.5 Identification of Mitigation Action Alternatives

FEMA Requirement

44 CFR Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include] a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. [The mitigation strategy] must also address the jurisdictions' participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

EMAP Standard (2013)

Standard 4.4.5: The mitigation plan shall be based on the natural and human-caused hazards identified by the Emergency Management Program and the risk and consequences of those hazards. The mitigation plan for the jurisdiction is developed through formal planning processes involving Emergency Management Program stakeholders and shall establish interim and long-term strategies, goals, objectives, and actions to reduce risk to the hazards identified. The Emergency Management Program implements a process and documents project ranking based upon the greatest opportunity for loss reduction and documents how specific mitigation actions contribute to overall risk reduction.

To update the mitigation actions from the previously approved plan, the responsible agency listed for each action completed a status worksheet describing whether the action was completed, incomplete, or ongoing and provided in Section 6.2. The LPC recognized that many of these actions are on-going standard practices and have reflected this in Section 6.2.

To begin identifying a range of the 2016 Plan mitigation strategies at the Risk Assessment Meeting on July 29, 2015, the LPC and stakeholders divided into four breakout groups by hazard (Wildfire, Flood/Dam and Levee Failure, Human-Caused Hazards, and Severe Weather/Geologic Hazards). Each breakout group was provided information about the hazard that summarized the greatest risk for Colorado Springs in the form of problem statements. Each breakout session included a diverse group of participants who could contribute their unique experience and perspective to the process. Based on the findings of the Risk Assessment and professional experience of the LPC and stakeholders, potential actions were identified that roughly followed the categories in Table 6-2.

Table 6-2: Categories of Mitigation Actions

Category	Definition
Prevention	Administrative or regulatory actions or processes that influence the way land and buildings are developed and built
Property Protection	Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area
Structural	Actions that involve the construction of structures to reduce the impact of hazard
Natural Resource Protection	Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems
Emergency Services	Actions that ensure the continuity of emergency services
Public Education and Awareness	Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them

Source: National Flood Insurance Program Community Rating System.

After the July 2015 meeting, a draft list of mitigation actions for each hazard was prepared for review at the Mitigation Strategy meeting in September 2015. At the Mitigation Strategy meeting, participants in the breakout sessions refined or modified the actions, evaluated and prioritized them which is discussed in greater detail in Section 6.6. Through this process, the LPC and stakeholders developed mitigation actions for each hazard and addressed both new and existing development. The list of mitigation actions is shown in Table 6-5.

The materials used during this process can be found in Appendix B. The process of developing the actions was based on the hazards identified in the risk assessment; included mitigation actions to be accomplished in the short and long-term; included actions requiring collaboration between public and private entities, and included a prioritization process based on Social, Technical, Administrative, Political, Legal, Environmental, and Economic (STAPLEE) criteria, thus meeting the intent of EMAP Standards 4.4.1 and 4.4.4.

For the 2016 Plan, the LPC and stakeholders broke out into four groups to discuss in detail strategies and actions to address risk from the hazards. This picture is of the Severe Weather and Geologic Hazards group from the Mitigation Strategy meeting in September 2015.

6.6 Prioritization and Implementation of Mitigation Actions

FEMA Requirement

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

As discussed earlier, at the third meeting on September 10, 2015, the LPC analyzed and prioritized the range of actions identified during the mitigation workshop breakout sessions. Mitigation actions were given priority if they were identified as short-term projects due to cost effectiveness and available resources. Other factors for prioritization were related to projects that were most vulnerable, have great social impact, are technically feasible, have limited environmental impact, have favorable economic impact, for which the administrative capabilities exist, those with potential politics, and the total expected costs. The LPC and stakeholders discussed and approved criteria for prioritizing the actions as part of the 2016 plan update

process. Similar to the 2010 plan, their criteria are based upon the STAPLEE method (Table 6-3), which assesses the social, technical, administrative, political, legal, economic, and environmental implications of each action. Each identified action was analyzed and ranked using the criteria defined in Table 6-4.

Table 6-3: STAPLEE Criteria Used for Prioritization of Mitigation Actions

Evaluation Criterion	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	• Community acceptance • Adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	• Technical feasibility • Long-term solutions • Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	• Staffing • Funding allocation • Maintenance/operations
Political	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management.	• Political support • Local champion • Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	• Local, state, and federal authority • Potential legal challenge
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete any necessary federal economic analysis criteria (e.g. FEMA Benefit-Cost Analysis).	• Benefit/cost of action • Contributes to other economic goals • Outside funding required • FEMA Benefit-Cost Analysis • Best bang for the buck
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	• Effect on local flora and fauna • Consistent with community environmental goals • Consistent with local, state, and federal laws

Source: FEMA, *Local Multi-Hazard Mitigation Planning Guidance*, 1 July 2008.

As part of the evaluation effort, the participants in the breakout sessions ranked each mitigation action as High, Medium, or Low priority. These priorities were based on the STAPLEE criteria, the likelihood of successful implementation, and general guidelines presented in Table 6-4. The LPC was asked to carefully review each action and priority, and develop a mitigation action implementation matrix that identified the following characteristics for each action or project:

- Priority
- Any project concerns based on STAPLEE criteria
- Responsible Organization

- Cost Estimate / Potential Funding Sources
- Timeline

Table 6-4: Prioritization Guidelines for Mitigation Actions

Priority	General Timeframe	Considerations
High	Begin within 1 year from plan adoption	Top organizational priority and is generally a well-details project idea. Protects population, resource, or property at high risk. Uses feasible methods, techniques, or technology.
Medium	2-3 years from plan adoption	A good idea that needs more information or is an action that addresses a moderate hazard.
Low	3-5 years from plan adoption	An idea that needs a lot more information or will take a lot of preliminary action to build support.

Participants in the Mitigation Strategy meeting breakout session that reviewed, evaluated, and prioritized mitigation actions for human-caused hazards.

As stated in the 2005 Plan: . . . *there are a significant number [of actions] that are already implemented using existing programs and policies. Others will be implemented as they go through the public process and are further coordinated and staffed to ensure they are viable.* This still holds true for the 2016 Plan and some of these actions are represented in Section 6.4.

Table 6-5 provides the prioritized mitigation actions for the City of Colorado Springs. The worksheets used for prioritization are included in Appendix B. A shortened version of the Mitigation Actions Matrix for the City's use during Plan Maintenance is included in Appendix D.

Table 6-5: Mitigation Actions Matrix

W1. Wildland-Urban Interface action	
Project Description/Comments	Formally define the WUI as a different polygon than the Hillside overlay. Make this distinction clear in the locally adopted codes and information materials.
STAPLEE Evaluation	Generally no concerns and will be modified during the next fire code adoption which is currently in process (as of 2015)
Hazard(s) Addressed	Wildfire
Responsible Organization	Division of the FM
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	Completed/adopted by 2016
Cost-Benefit Review	Due to relatively low cost and property protection/life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

W2. Wildfire Mitigation Education and Outreach to Neighborhoods at Risk	
Project Description/Comments	Continue conducting wildfire presentations to neighborhoods in order to educate them on mitigation concepts. One consideration for project prioritization is based on the receptiveness of the community. Roughly 111 neighborhoods are participating.
STAPLEE Evaluation	Administrative – will need additional funding allocated for staff, equipment and materials as program continues to grow
Hazard(s) Addressed	Wildfire
Responsible Organization	Division of the FM
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	Ongoing
Cost-Benefit Review	Due to relatively low cost and property protection/life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

W3. Wildfire Mitigation Fuel Reduction Activities	
Project Description/Comments	Continue fuels reduction activities to include neighborhood chipping, creating defensible around homes using residential stipends, prescribed burning in remote areas, and hazard fuel reduction projects in common areas and open spaces.
STAPLEE Evaluation	Economic – very dependent on grant funding sources, Environmental – must work in consideration of cultural areas and environmental considerations, Social – everything in stewardship with the land owner, Administrative – Depending on demand and funding available, will need additional staff and office space to operate effectively.
Hazard(s) Addressed	Wildfire
Responsible Organization	Division of the FM
Estimated Costs	Medium to High

W3. Wildfire Mitigation Fuel Reduction Activities	
Possible Funding Source	As of 9/2015, Colorado Springs applied for a Colorado Department of Natural Resources Wildfire Risk Reduction Grant Program grant and will continue to apply for future ones.
Timeline for Implementation	Ongoing
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs. Bio-fuel could be a means to eliminate disposal costs and create additional fuel source.
Priority	***High***

W4. Wildfire Mitigation Outreach to the Business Community	
Project Description/Comments	Expand Business Education and Outreach about wildfire concerns, evacuation, and business continuity. Continue integration with the Division of the Fire Marshal's current efforts focused on businesses and healthcare facilities. Explore expanding outreach to adopt an all-hazards perspective in partnership with OEM.
STAPLEE Evaluation	Economic – need funding to expand this program; Political – have administrative support – need equipment and resources to expand this program and the demand is more than Wildfire Mitigation can meet at current staffing levels.
Hazard(s) Addressed	Wildfire
Responsible Organization	Division of the FM and OEM
Estimated Costs	Staff time to Low cost
Possible Funding Source	Corporate grants, private and non-profit grants, state and federal government.
Timeline for Implementation	Depends if and when resources are available
Cost-Benefit Review	Due to relatively low cost and avoidance of economic disruption/ life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

W5. Enhance WHINFOE Risk Model	
Project Description/Comments	Enhance the Wildfire Hazard Information Extraction (WHINFOE) risk model to include adjacency of structures and urban conflagration potential.
STAPLEE Evaluation	Administrative – need staff and funding to complete this; Political – would have to conduct a public process
Hazard(s) Addressed	Wildfire
Responsible Organization	Division of the FM, Colorado Springs Information Technology (IT) Department
Estimated Costs	Low to Medium
Possible Funding Source	Various state and federal sources relating to wildfire risk analysis (e.g., FEMA)
Timeline for Implementation	Depends on funding
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Medium***

F1. Templeton Gap Floodway Accreditation	
Project Description/Comments	Obtain documentation regarding the floodway's accreditation status from USACE and FEMA. Determine if the City should seek accreditation.
STAPLEE Evaluation	Social – park infrastructure/St. Mary's Stadium, Technical – unsure if technical support is needed, Environmental

F1. Templeton Gap Floodway Accreditation	
Hazard(s) Addressed	Flood/Levee failure
Responsible Organization	Public Works/Stormwater
Estimated Costs	Staff time
Possible Funding Source	Staff work to obtain documentation
Timeline for Implementation	3-5 years
Cost-Benefit Review	The low cost of obtaining documentation of the floodway's status is expected to be outweighed by the benefits. The cost-benefit of obtaining accreditation, if needed, will require more in-depth analysis.
Priority	***Low***

F2. Assess Flood Risk for Critical Populations	
Project Description/Comments	Assess the risk for facilities with critical populations (schools, nursing homes, etc.). Consider the need for site-specific EAPs for locations.
STAPLEE Evaluation	Social and economic concerns need to be addressed
Hazard(s) Addressed	Flood
Responsible Organization	City Planning, Pikes Peak Regional Building Department
Estimated Costs	Staff time/low cost for assessment
Possible Funding Source	Staff work and grants to evaluate risk (FEMA)
Timeline for Implementation	2-3 years
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Medium***

F3. Educate Critical Populations of Flood Risk	
Project Description/Comments	Educate critical populations (schools, nursing homes) of their flood risk and the need to take safety measures. Second step is to assess the risk for critical facilities.
STAPLEE Evaluation	Social concern
Hazard(s) Addressed	Flood
Responsible Organization	OEM, Fire Department Public Information Office (PIO), City Communications
Estimated Costs	Staff time
Possible Funding Source	Staff work
Timeline for Implementation	Education – Ongoing
Cost-Benefit Review	Due to relatively low cost and avoidance of property damage/life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

F4. Address Erosion and Sloughing on Stream Banks	
Project Description/Comments	Evaluate additional feasible and functional ways to reduce or eliminate erosion and sloughing on stream banks. Include long-term maintenance considerations in the evaluation.
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Flood
Responsible Organization	Public Works/Stormwater

F4. Address Erosion and Sloughing on Stream Banks	
Estimated Costs	Low to Medium
Possible Funding Source	Staff time for evaluation; Grants needed for Implementation (e.g., FEMA)
Timeline for Implementation	3-5 years
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Low***

F5. Mitigation on Non-Burn Scar Area Streams	
Project Description/Comments	Implement mitigation actions on non-burn scar streams including: o In-channel improvements for stability o Detention o Zero run-off increase from new development
STAPLEE Evaluation	Political, social
Hazard(s) Addressed	Flood
Responsible Organization	Public Works/Stormwater
Estimated Costs	Medium to High
Possible Funding Source	Staff time, Mitigation grants (e.g., FEMA)
Timeline for Implementation	On-going
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs but individual projects may need separate and detailed benefit-cost analyses
Priority	***Low***

F6. Emergency Action Plans for Streams in Monument Creek Watershed	
Project Description/Comments	Monument Creek is the downstream receiving water for many dams where a failure could affect Colorado Springs. Verify that EAPs are available for all higher risk upstream dams.
STAPLEE Evaluation	Political, Legal
Hazard(s) Addressed	Dam Failure
Responsible Organization	CSU, City Parks and Recreation, OEM – non CSU and Parks and Recreation dams
Estimated Costs	Low
Possible Funding Source	Staff time to monitor and maintain dam EAPs
Timeline for Implementation	Ongoing
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Low***

F7. Evaluation of Enhancements and Enforcement of the Flood Ordinance	
Project Description/Comments	Evaluate the potential of implementing code and/or regulations revisions to further limit or eliminate development in the 100-year floodplain. Enforce current code – don't permit exceptions and variances
STAPLEE Evaluation	Political, Social
Hazard(s) Addressed	Flood
Responsible Organization	Planning, Public Works, Pikes Peak Regional Building Department

F7. Evaluation of Enhancements and Enforcement of the Flood Ordinance	
Estimated Costs	Staff time
Possible Funding Source	City budget, Staff time
Timeline for Implementation	On-going
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Low***

F8. Drainage Criteria Manual Update	
Project Description/Comments	Consider updating the Drainage Criteria Manual to provide specific guidelines for accommodating long-term maintenance (access, etc.) in the design requirements for storage (sediment catchment and stormwater detention) basins. Update the City of Colorado Springs Drainage Criteria Manual, Volume 1 & Volume 2, to provide for Sustainable and Resilient Stormwater.
STAPLEE Evaluation	Political, Social, Technical
Hazard(s) Addressed	Flood
Responsible Organization	Public Works
Estimated Costs	Staff time to Low
Possible Funding Source	City budget; State grants
Timeline for Implementation	3-5 years
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
Priority	***Medium***

F9. Public Awareness and Messaging about Dams	
Project Description/Comments	Implement public awareness campaign about dams which includes: o Develop a public relations plan to increase public awareness about the dams in Colorado Springs o Develop Public Safety messages for Dam Failure o Target the spring time (2016) in preparation for the monsoon season
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Dam Failure
Responsible Organization	CSU, City Parks and Recreation, OEM
Estimated Costs	Staff time
Possible Funding Source	City staff budget
Timeline for Implementation	Immediate and on-going
Cost-Benefit Review	Due to relatively low cost and potential life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

F10. Gauge-Adjusted Radar Rainfall (GARR) System	
Project Description/Comments	Re-evaluate the cost/benefit of integrating the available rain gauges with the Gauge-Adjusted Radar Rainfall (GARR) System. Re-evaluate the feasibility and cost/benefit of improving the reporting speed of rain gauges already in place.
STAPLEE Evaluation	No concerns

F10. Gauge-Adjusted Radar Rainfall (GARR) System	
Hazard(s) Addressed	Flood
Responsible Organization	OEM
Estimated Costs	Staff time
Possible Funding Source	City staff budget
Timeline for Implementation	3-5 years
Cost-Benefit Review	Potential life safety benefit may outweigh costs
Priority	***Low***

F11. Property Acquisition	
Project Description/Comments	Coordinate the acquisition of eligible properties with property owners and State/Federal programs.
STAPLEE Evaluation	Legal – May need to consider new and/or revised codes. Economic – The funding for acquisition is dependent on State and Federal grant programs.
Hazard(s) Addressed	Flood
Responsible Organization	Public Works, OEM, Parks and Recreation, Real Estate Services, Planning
Estimated Costs	High,
Possible Funding Source	Staff time, State and Federal grant programs.
Timeline for Implementation	Ongoing
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh costs
Priority	***Medium***

SW1. Burial of Utilities	
Project Description/Comments	Continue to bury utilities underground as feasible.
STAPLEE Evaluation	Technical and economic concerns (mostly economic); some political concerns
Hazard(s) Addressed	Severe Weather
Responsible Organization	CSU
Estimated Costs	High (three to five times the cost of overhead lines)
Possible Funding Source	To be determined
Timeline for Implementation	3-5 years
Cost-Benefit Review	Burying utilities is expensive and individual benefit-cost analyses would need to run
Priority	***Low***

SW2. Tree Trimming and Vegetation Management	
Project Description/Comments	Continue to trim trees and vegetation along power line corridors and infrastructure. o Evaluate whether the City can support vegetation trimming via cost-sharing methods o CSU has a program in place
STAPLEE Evaluation	Environmental – permits to chop down trees; Economics
Hazard(s) Addressed	Severe Weather

SW2. Tree Trimming and Vegetation Management	
Responsible Organization	CSU, City Forestry, Parks and Recreation. Coordination needed with Fire Department for on-going chipping efforts.
Estimated Costs	Low to Medium
Possible Funding Source	CSU and City of Colorado Springs
Timeline for Implementation	3-5 years
Cost-Benefit Review	Due to multiple benefits from tree-trimming, benefits expected to outweigh costs
Priority	***Low***

SW3. Severe Weather Public Outreach and Education	
Project Description/Comments	Provide more information and outreach to the public on hazardous weather risks and mitigation actions so they can better protect themselves and property. American Red Cross has a good app that is free. These are tools for the end user and apps are either free or low cost.
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Severe Weather
Responsible Organization	City Communications, National Weather Service
Estimated Costs	Red Cross apps are free. Weather Radio (formerly iMAP) app ($5one-time fee). Local TV Station apps
Possible Funding Source	National Weather Service
Timeline for Implementation	Immediate and on-going
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

SW4. Evaluate Need for Severe Weather Protection in Building Codes	
Project Description/Comments	Influence building codes to mitigate for severe weather. This could be implemented more readily for City-owned properties. Evaluate whether certain roof types could be required to mitigate the impacts of hail and damaging winds.
STAPLEE Evaluation	Economic, political, legal
Hazard(s) Addressed	Severe Weather
Responsible Organization	Pikes Peak Regional Building Department
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	3-5 years
Cost-Benefit Review	Due to relatively low cost and benefits of avoided damage, the overall benefits are anticipated to outweigh costs. Would need to better understand economic impact on new construction
Priority	***Low***

SW5. Public Messaging to Avoid Hazardous Areas	
Project Description/Comments	Purchase variable message signs for use at key locations to warn motorists of ice so they can avoid these areas. Evaluate need for portable signs versus permanent ones. o Locations include: Austin Bluffs Parkway either side of UCCS and North Carefree, and other identified "trouble" spots o These signs could also be used for wildfire, HAZMAT, traffic incidents or Amber Alerts
STAPLEE Evaluation	Social and political – placement of signs, Economic, Legal - no digital signage ordinance in the City but message signs would likely be exempt
Hazard(s) Addressed	Severe Weather (all hazards and construction projects also)
Responsible Organization	City Streets
Estimated Costs	Portable signs are lower costs; Permanent higher (~$250K)
Possible Funding Source	Grants from Federal Highway Administration
Timeline for Implementation	1 to 2 years
Cost-Benefit Review	Costs and benefits would need to evaluated per site but strategic positioning of signs could help avoid costly traffic jams
Priority	***High***

SW6. Evaluate Need to Modify Building Codes for Drought/Water Conservation	
Project Description/Comments	Review building codes to encourage xeriscape landscapes.
STAPLEE Evaluation	No concerns identified
Hazard(s) Addressed	Severe Weather
Responsible Organization	CSU
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	Ongoing
Cost-Benefit Review	Due to relatively low cost and benefits of avoided economic disruption, the overall benefits are anticipated to outweigh costs
Priority	***Low***

G1. Landslide Monitoring	
Project Description/Comments	The City should proactively monitor landslides with GPS or pendulum technology. Some technology is costly. Property owners can participate in monitoring.
STAPLEE Evaluation	Economic, Political, Social
Hazard(s) Addressed	Geologic Hazards
Responsible Organization	City Building Department, OEM
Estimated Costs	Low to Medium
Possible Funding Source	USGS; University Research; Grants (e.g., FEMA)
Timeline for Implementation	Cooperate with USGS; Colorado Geologic Survey; University for Grant and CTP activities
Cost-Benefit Review	Costs range to medium so a more detailed cost-effectiveness evaluation would need to be conducted on a per project basis.
Priority	***High – OEM to do more outreach on landslides; Medium – GPS Technology***

G2. Earthquake Outreach and Education	
Project Description/Comments	Provide outreach to the public on earthquake risk and mitigation actions they can take to protect themselves and their property.
STAPLEE Evaluation	No concerns identified
Hazard(s) Addressed	Geologic Hazards
Responsible Organization	OEM
Estimated Costs	Staff time
Possible Funding Source	USGS and staff budget
Timeline for Implementation	1-year. More outreach needed on the risk to create more awareness
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

G3. Landslide Building Codes	
Project Description/Comments	Evaluate the need to modify building codes for landslide susceptible locations within the City's limits. Modify and enforce landslide mitigation requirements and work to ensure against building in areas identified as at-risk to landslides.
STAPLEE Evaluation	No concerns identified
Hazard(s) Addressed	Geologic Hazards
Responsible Organization	City Planning Department/Pikes Peak Regional Building Department
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	3-5 years
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

G4. Property Acquisition	
Project Description/Comments	Coordinate the acquisition of eligible properties with property owners and State/Federal programs.
STAPLEE Evaluation	Legal – May need to consider new and/or revised codes. Economic – The funding for acquisition is dependent on State and Federal grant programs.
Hazard(s) Addressed	Flood
Responsible Organization	Public Works, OEM, Parks and Recreation, Real Estate Services, Planning
Estimated Costs	High,
Possible Funding Source	Staff time, State and Federal grant programs.
Timeline for Implementation	Ongoing
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh costs
Priority	***Medium***

H1. Terrorism Public Awareness	
Project Description/Comments	Continue Public Awareness on terrorism risk: o Promote public awareness campaign of shared responsibility and how the public should notify law enforcement of suspicious behavior ("See something, Say something") o Sustain capability to use Integrated Public Alert and Warning System (IPAWS) o Continue support of Civil-Military Emergency Management Collaborative
STAPLEE Evaluation	Social/Political – Do not want to cause undue fear of terrorist acts.
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	CSPD, Communications, PIO, OEM
Estimated Costs	Staff time
Possible Funding Source	Staff budget and DHS
Timeline for Implementation	Annually and as needed
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H2. Collaboration to Address Terrorism Risk	
Project Description/Comments	Enhance collaboration and coordination among Law Enforcement, Emergency Management, and other intelligence-gathering agencies to address terrorism threats o Increase participation in monthly Regional Threat Working Group meetings with CIAC which are focused on terrorist/criminal threat. CSU also has a monthly meeting. o Coordinate with Colorado DHSEM security representative.
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	CSPD, Colorado DHSEM, CIAC, CSU
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	Immediate and on-going
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H3. Hazardous Materials Readiness and Warning Capabilities	
Project Description/Comments	Continue improving readiness and warning to appropriate officials and public for potential HAZMAT incidents for public safety and to reduce secondary impacts o Sustain capability of using IPAWS for public warning o Continue to plan HAZMAT exercises o Prepare pre-scripted messages for IPAWS o Consider ways to quickly inform public. Work with media.
STAPLEE Evaluation	Social/Political – develop appropriate messaging including what people should do, Environment
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	OEM, CSPD Communications, CSFD

H3. Hazardous Materials Readiness and Warning Capabilities	
Estimated Costs	Staff time to Low (for exercises)
Possible Funding Source	Staff budget and DHS (IPAWS)
Timeline for Implementation	Immediate and on-going - incorporate into OEM planning tabletop for HAZMAT in spring of 2016.
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H4. Sustain Tier II Reporting	
Project Description/Comments	Sustain Tier II facility reporting using the Hazardous Materials Management and Emergency Reporting System (HAMMERS).
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	LEPC, CSFD
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	Immediate and on-going
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H5. Coordination with Railroad on Hazardous Materials Incidents	
Project Description/Comments	Continue to coordinate with the railroad industry to improve collaboration and response in case of large HAZMAT incident
STAPLEE Evaluation	No concerns
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	OEM, CSFD
Estimated Costs	Staff time to Low
Possible Funding Source	Staff budget, DHS
Timeline for Implementation	Immediate and on-going – HAZMAT Tabletop and Functional Exercises (one planned in Spring 2016)
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H6. Enhance Public Education on Infectious Disease	
Project Description/Comments	Continue public education for infectious disease on several topics including vaccinations, emerging diseases, and things to avoid (e.g., animal carcasses). Raise awareness of El Paso County Health Department's website.
STAPLEE Evaluation	Social
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	EPCPH, CDPHE
Estimated Costs	Staff time
Possible Funding Source	Staff budget

H6. Enhance Public Education on Infectious Disease	
Timeline for Implementation	Immediate and on-going
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***High***

H7. Evaluate Infectious Disease Response Operations	
Project Description/Comments	Review response operations to intervene and stop the spread of infectious disease o Maintain awareness of infectious disease response roles and responsibilities o Maintain a strong relationship with EPCPH o Participate in Public Health Exercises o Educate public on what would happen if they were quarantined and resources that can support them during it o Conduct an exercise for setting up Point of Dispensing locations
STAPLEE Evaluation	With measles outbreak concern in 2015, the City and El Paso County have gone through one scenario. Quarantine is a political, social, legal concern.
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	EPCPH, OEM, CDPHE, CSPD, El Paso Sheriff's Office, El Paso County OEM
Estimated Costs	Staff time to Low
Possible Funding Source	CDC, DHS
Timeline for Implementation	On-going
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

H8. Cyber Threat Education and Awareness	
Project Description/Comments	Implement education and awareness activities for City of Colorado Springs employees to reduce cyber threats and hacking via phishing attacks. Formalize training program and Tabletop Cyber Scenarios.
STAPLEE Evaluation	Administrative is concern because the IT Department is currently overloaded
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	IT, OEM
Estimated Costs	Staff time
Possible Funding Source	Staff budget
Timeline for Implementation	1-2 years
Cost-Benefit Review	Due to relatively low cost and avoidance of disruption, loss of critical data benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

H9. Continuity of Operations	
Project Description/Comments	Evaluate Continuity of Operations scenarios if technology is incapacitated (e.g., no phones, no computer) o Use of 800 megahertz, VHF, and ham radios, hardline phones, and courier services o Conduct exercises

H9. Continuity of Operations	
	o Explore contracting with mobile companies that can help restore functionality to internet o Mobile telephone companies will provide some cellular service free of charge during an emergency
STAPLEE Evaluation	No concerns identified
Hazard(s) Addressed	Human-caused hazards
Responsible Organization	OEM IT, OEM, CSPD, CSFD, Contracting (for agreements)
Estimated Costs	Staff time to Medium (for equipment and contracting)
Possible Funding Source	Staff budget; DHS
Timeline for Implementation	1-2 years
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
Priority	***Medium***

Continued Compliance with National Flood Insurance Program

The City of Colorado Springs currently participates in the NFIP. The City also participates in the CRS program with a current rating of Class 6. Colorado Springs will continue participation in and compliance with the NFIP. Specific activities that the City will undertake to continue compliance include the following:

- Working with FEMA and the State in the Risk MAP program and adopting new DFIRMs when effective
- Improving education and outreach efforts regarding flooding throughout the City
- Maintain the Class 6 rating in the CRS program; strive for enhanced score in next five years

7. Plan Maintenance

This chapter provides a formal process to ensure that the 2016 Plan remains an active and relevant document. The plan maintenance process includes a method and schedule for all participating jurisdictions to participate in the process of monitoring, evaluating, and updating the plan. This chapter also discusses the incorporation of this plan into existing planning mechanisms and continued public involvement.

7.1 2016 Plan

The previously approved plan identified plan maintenance procedures including a method for monitoring, evaluating and updating the plan, implementing the plan through existing programs, and continued public involvement. The plan maintenance procedures identified in this 2016 edition include an additional checklist for a slightly more detailed approach.

7.2 Monitoring, Evaluating, and Updating the Plan

FEMA Requirement

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

EMAP Standard (2013)

Standard 4.4.4: The Emergency Management Program shall implement a process to monitor overall progress of the mitigation strategies, document completed initiatives, and resulting reduction or limitation of hazard impact in the jurisdiction.

Plan Monitoring and Evaluating

The plan maintenance procedures described in this chapter were presented to the LPC and stakeholders to gain concurrence. The process outlined in this section meets the intent of EMAP Standard 4.4.4 by providing a clear monitoring process that documents progress prior to the next update. As in the 2010 Plan, the City of Colorado Springs OEM will serve as the primary point of contact and will coordinate all local efforts to monitor, evaluate, and update the plan. The City of Colorado Springs will be responsible for implementing their specific mitigation actions and reporting on the status of these actions to the OEM. The 2016 Plan provides detail as to how the plan will specifically be monitored including general timeframe and responsible parties.

From some of the 2010 actions, OEM will adopt an on-going process to perpetuate these into the future and they are removed from the 2016 action list. These actions will be included in the Annual Mitigation Plan Progress Report.

The LPC will evaluate the implementation status of the City of Colorado Springs HMP annually. OEM is responsible for coordinating this effort.

The purpose will be the following:

- Report on usefulness of the Plan and the progress on mitigation actions
- Report on any input received from the public
- Discuss hazard events and observations
- Report on how the plan has been incorporated into other planning mechanisms
- Discuss mitigation issues and ideas
- Work to secure funding and identify multi-objective, cost-share, and other opportunities for partnerships
- Discuss how to keep the attention of community leaders and the public on hazard mitigation problems and opportunities
- Discuss new sources for data to improve future updates
- Make recommendations on specific updates to the plan

OEM will email the Annual Mitigation Plan Progress Report (included in Appendix D) to each agency responsible for actions in the plan a minimum of two weeks prior to the scheduled meetings. These progress reports serve as criteria by which the mitigation strategy may be evaluated. During the meeting, the group will review and discuss their progress and how they have utilized the plan.

The Annual Mitigation Plan Progress Report will be incorporated into OEM's Annual Report. After considering the findings of the submitted progress reports, the City Council and or the LPC may request that the implementing department or agency meet to discuss project conditions. Should review of the Plan warrant changes prior to the five-year update cycle, a notice and revised document will be provided to the City Council, the state and FEMA following the review and update.

Plan Update Process

For this update, the Colorado Springs OEM will continue the five-year plan update process within the time necessary to ensure that the current plan does not expire before the updated plan is approved. The schedule will be sufficient to allow for the contracting for technical or professional services (if necessary); state and FEMA reviews; revisions, if necessary, based on FEMA review comments; and the adoption procedures of the participating jurisdictions. OEM will coordinate the participation of the jurisdictions. The updated plan will meet FEMA's requirements and do the following:

- Consider changes in vulnerability due to action implementation
- Document areas where mitigation actions were or were not effective
- Incorporate new data or studies on hazards and risks
- Incorporate new capabilities or changes in capabilities
- Incorporate growth and development-related changes to inventories
- Incorporate new action recommendations or changes in action prioritization

The LPC will also meet after a disaster to focus on the following items:

- Identify potential mitigation projects, particularly those eligible for mitigation grant programs if available
- Evaluate effectiveness of existing mitigation projects
- Reassess hazard profiles and vulnerability

Updates to the Plan will be accomplished through written changes and submissions incorporated by the City of Colorado Springs OEM.

7.3 Incorporation into Existing Planning Mechanisms

FEMA Requirement

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

EMAP Standard (2013)

Standard 4.4.3: The Emergency Management Program provides technical assistance consistent with the scope of the mitigation program such as implementing building codes, fire codes, and land-use ordinances.

The City of Colorado Springs OEM, with support and guidance provided by the LPC, will work with the responsible agencies to incorporate this plan into the following existing planning mechanisms (and future updates of these mechanisms) where possible:

- City of Colorado Springs Master Plan
- City of Colorado Springs CWPP (scheduled for update in 2016)
- City of Colorado Springs Catastrophic Incident Annex
- City of Colorado Springs Emergency Operations Plan
- Evacuation Plans
- Building Codes
- Site Plan Review
- Zoning, subdivision, and floodplain ordinances
- Capital improvement plan and City budgets
- Economic Development Plans
- Urban Renewal Plans
- Historic Preservation Plans
- Other plans and policies outlined in the Capability Assessment (Section 5.)

Incorporation of plan elements into existing planning mechanisms will require coordination between OEM and the staff of the department responsible for drafting the plan document. This will ensure that the relevant elements of this Plan are taken into consideration. Incorporation of this plan into other planning mechanisms was specifically addressed in the 2010 Plan mitigation strategy as action number *B-2: Develop a strategy to integrate the PDM plan with the City's strategic plan and other long-term planning documents.* This effort will carry forward in the Annual Plan Progress Report.

These guidelines for incorporating existing planning mechanisms meet the EMAP Standard 4.4.3 by clearly outlining the strategy for integration.

7.4 Continued Public Involvement

FEMA Requirement

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

The LPC is committed to identifying additional opportunities to raise community awareness about the plan and mitigation efforts in the City of Colorado Springs. It will continue supporting the City's outreach efforts like Flood Preparedness Meetings. This section also partially meets EMAP Standard 4.4.4 by addressing an education and outreach strategy. The plan document will be posted on the webpage of the City of Colorado Springs OEM. The website will contain an e-mail address and phone number to which people can direct their comments or concerns.

OEM will update and track the Plan's progress at a regularly scheduled meeting on an annual basis. The Plan and corresponding status updates will be made available to the public.

OEM and other members of the LPC will also identify opportunities to raise community awareness about the Plan and the hazards that affect the City of Colorado Springs. This effort could include attendance and provision of materials at City or County events, school-sponsored events, activities of the fire protection districts, through the American Red Cross, events through other organizations, or by public mailings.

Any public comments received about the Plan will be collected by OEM and included in the Annual Plan Progress Report. During the plan update process, OEM will develop a schedule for the public to submit comments to be considered for incorporation into the Plan, as appropriate. All public comments will be attached as an appendix to plans that are submitted for approval by the state and FEMA.