

CITY OF WESTMINSTER
Hazard Mitigation Plan
2023-2028



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1 INTRODUCTION

1.1 Purpose

The City of Westminster Colorado has prepared this Multi Hazard Mitigation Plan to guide hazard mitigation planning to better protect the people and property of the City of Westminster from the effects of hazard events. The plan was originally prepared in 2009-2010, updated in 2017-2018 and again in 2022-2023. It demonstrates the city's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. Other purposes include making the City of Westminster eligible for federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grant programs including the Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), and the Pre-Disaster Mitigation (PDM) program, as well as earning points for the National Flood Insurance Program's (NFIP) Community Rating System (CRS) to lower flood insurance premium communitywide.

1.2 Background and Scope

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural hazards are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." 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). An update to this report in 2018 (Natural Hazard Mitigation Saves: 2018 Interim Report) indicates that mitigation grants funded through select federal government agencies, on average, can save the nation \$6 in future disaster costs for every \$1 spent on hazard mitigation.

Hazard mitigation planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set and appropriate strategies to lessen impacts are determined, prioritized and implemented. This plan documents the City of Westminster's natural hazards mitigation planning process, identifies relevant natural hazards and risks, and identifies the strategies the city will use to decrease its vulnerability and increase its resiliency and sustainability.

The City of Westminster's Natural Hazards Mitigation Plan is a single-jurisdiction plan that covers the incorporated community of the City of Westminster. It documents the city's natural hazards mitigation planning process, identifies natural hazards and associated risks to the city, and develops a hazard mitigation strategy to lessen vulnerability and improve resiliency to natural disasters, thereby enhancing the city's long-term sustainability.

The city prepared this hazard mitigation plan update pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 CFR §201.6), finalized October 31, 2007 and updated in 2012. Hereafter, these requirements and regulations will be referred to collectively as the DMA. On April 19, 2022 FEMA updated the State and Local Mitigation Policy Guides (policies). On April 19, 2023 they went into effect. This means that all state and local plans must meet the updated requirements. The policies are the official interpretation of the requirements in the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended. They are also the interpretation of the requirements in other federal statutes and regulations, specifically Title 44 Code of Federal Regulations (CFR) Part 201 Mitigation Planning. Changes and updates now include:

- Requires local governments to include the effects of future conditions in their risk assessments.
- Define who local governments must include in the planning process.
- Highlight how adopting and enforcing building codes and land use and development ordinances affects how the local government can improve mitigation capabilities.
- Make it easy to align with other FEMA mitigation programs such as the NFIP, Community Rating System, and flood risk mapping program.
- Lay out the need to right-size the scope of a plan update, weigh both current and future risks, and complete the planning process by adopting the plan. Include current mitigation plan requirements for the HHPD grant program to include all dam risks; remove the optional Repetitive Loss Strategy.
- Rearrange requirements for ease of use.

Due to the City of Westminster being subject to many kinds of natural hazards, access to federal hazard mitigation assistance programs is vital. This plan addresses natural hazards only. Although the Hazard Mitigation Planning Committee (HMPC) recognizes that FEMA encourages communities to address manmade and technological hazards as well as natural hazards, the scope of this effort was limited to natural hazards for two reasons: 1) many of the planning activities for manmade and technological hazards are either underway or complete and were developed by a different set of organizations and 2) the DMA requires extensive public information and input, which is in direct conflict with the confidentiality necessary in planning for the fight against chemical, biological and radiological terrorism. The HMPC determined it was not in the community's best interest to publicly share specific information about the area's vulnerability to manmade hazards. Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to the city and its property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. Westminster has been affected by natural hazards in the past and is thus committed to reducing disaster impacts and maintaining eligibility for federal funding.

1.3 Plan Organization

The City of Westminster's Multi Hazard Mitigation Plan is organized as follows:

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption
- Chapter 7: Plan Implementation and Maintenance
- Appendix A: References
- Appendix B: Planning Process Documentation
- Appendix C: Adoption Resolution
- Appendix D: Mitigation Categories, Alternatives, and Selection Criteria

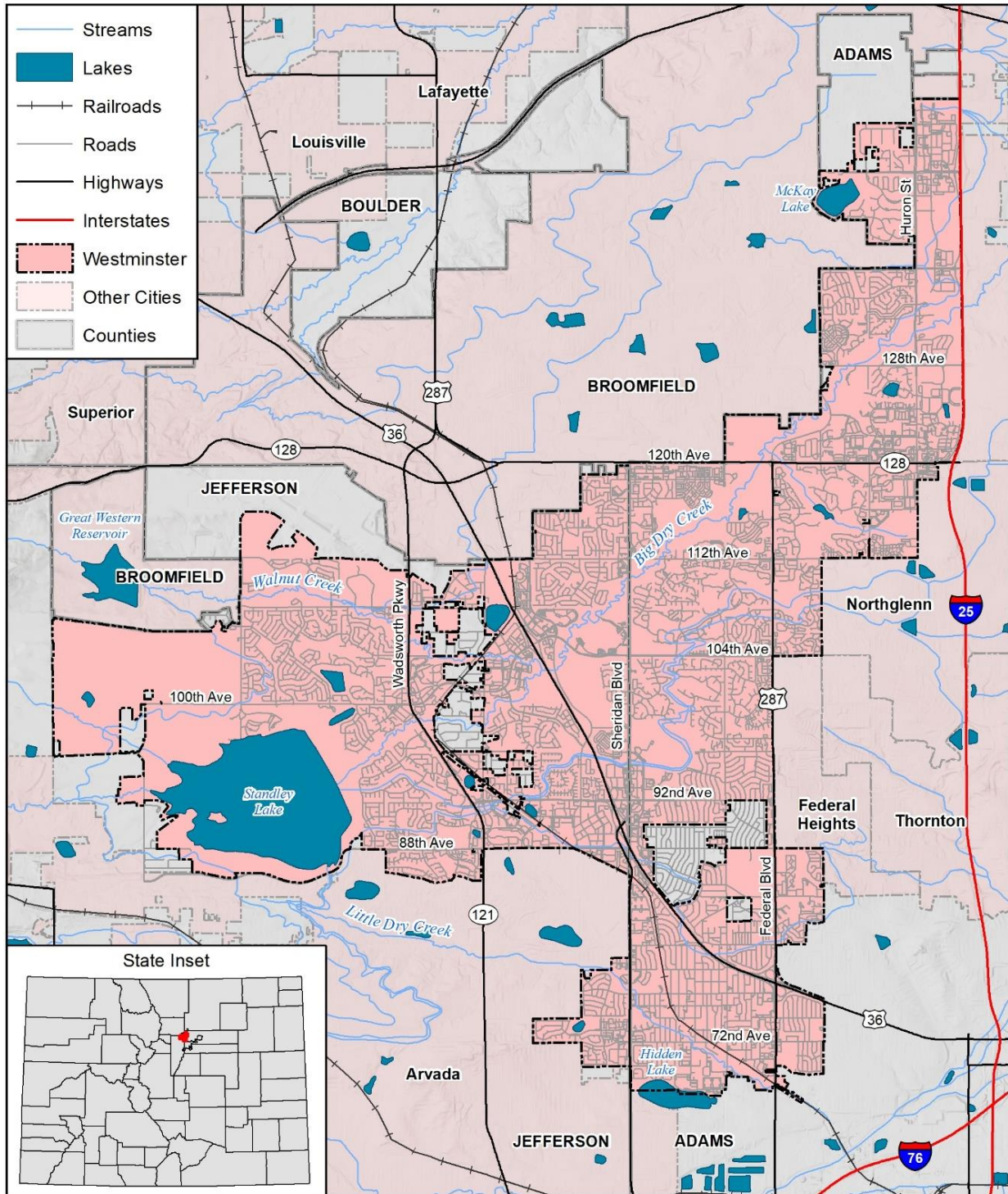
2 COMMUNITY PROFILE

The City of Westminster is located approximately midway between Denver and Boulder and overlaps portions of Jefferson and Adams counties. Westminster is an award-winning community with an international reputation for livability, excellent recreation facilities, leadership in technology and sound fiscal management, and has even been recognized for its promotion of solar energy and level of digital savvy (Explore Westminster-About the City, n.d.). Westminster is a full-service city providing police, fire and emergency medical services, water and wastewater treatment, street construction and maintenance, parks, recreation, library services and various other services. Due to its location and the large variety of amenities it offers, Westminster has grown very quickly. The city has reached capacity with its annexation program and has entered a new era of sustainability and infill development to support new growth. It is a home-rule municipality with a council-manager form of government. The elected City Council, which consists of the Mayor, the Deputy Mayor, and five council members, sets policies for the operation of the city government and appoints the City Manager, who is tasked with the day-to-day administrative responsibilities of the city.

2.1 Geography:

The City of Westminster is located 5,384 feet above sea level and lies in the northwest quadrant of the Denver metropolitan area, between Boulder and Denver. It is bisected by the Denver/Boulder Turnpike (US 36) and is adjacent to I-25. Westminster is 35.51 square miles and is on the edge of the high plains with gently rolling topography. Most development in the city consists of infill as approximately 95 percent of the city is built out. The primary land use is residential, followed by business and commercial land uses including 26 business parks, 68 retail centers and some light manufacturing. Westminster incorporates 3,067 acres of open space and 109 miles of trails. The city's largest body of water, approximately 1,200 acres, is Standley Lake. The city is also bisected by Big Dry Creek in the north and Little Dry Creek in the south.

Figure 2-1 City of Westminster Boundaries and Planning Area



WSP Map compiled 11/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT

0 1 2 Miles



2.2 Climate and Weather

Westminster is at the western edge of the Eastern Plains of Colorado. The climate of the plains is comparatively uniform from place to place, with characteristic features of low relative humidity, abundant sunshine, infrequent rains and snow, moderate to high wind movement and a large daily and seasonal range in temperature. Summer daily maximum temperatures are often 95°F or above. Due to the very low relative humidity accompanying these high temperatures, hot days cause less discomfort than in more humid areas. The usual winter extremes range from zero to -15°F but have reached extraordinarily low readings of -30 to -40°F during some of the most extreme cold waves. The record temperatures for Westminster are -29 and 105°F.

A large proportion of precipitation (70 to 80 percent of the annual total) falls during the growing season from April through September. Midwinter precipitation is light and infrequent. More often, winter brings dry air and strong winds contributing to the aridity of the area. From early March through early June, periodic widespread storms bring soaking beneficial moisture. Summer precipitation comes largely from thunderstorm activity and is sometimes extremely heavy. Localized rains in excess of four inches sometimes fall in just a few hours contributing to local flooding. Many years are drier than average and some years receive only half or less of the long-term average. Multi-year drought is common to the area such as the decade-long drought of the 1930s, the severe drought of the mid-1950s and 1970s and the intense widespread drought of the early 2000s.

Westminster's location near the foothills and mountains affects the average wind speeds. This effect is less than on the plains, but areas closer to the mountains are subject to periodic, severely turbulent winds from the effects of high westerly winds over the mountain barrier. These winds are sometimes referred to as "chinook winds" when they warm, and "bora winds" when they are associated with a strong cold frontal passage and downslope off of the mountains. Precipitation, which decreases gradually from the eastern border to a minimum near the mountains, increases rapidly with the increasing elevation of the foothills and proximity to higher ranges. The decrease in temperature from the eastern boundary westward to the foothills is less than might be expected with increasing altitude. This results from mountain and valley winds and greater frequency of the chinook.

2.2.1 Monthly Weather Summaries

Westminster enjoys generally moderate and pleasant weather. However, in the late spring and early fall, the weather can be highly variable and rapidly changing. Although prolonged heat events can occur during the summers, low humidity helps mitigate the effects. The altitude, low humidity and high UV index increase the risk of dehydration, sunburn and sun stroke. Severe weather events are being tracked and reported with greater warning and accuracy which helps provide ample opportunity to seek shelter if necessary.

The following monthly summaries are based on a general review of historic weather events for each month. They do not reflect non-event days that produced no remarkable weather.

January

Rapid temperature shifts of 30 degrees in two hours are common as well as high winds (50-100mph) that have been known to overturn trucks, mobile homes, etc. The temperature may stay below zero for days to over a week. Heavy snows (8-16 inches) are common and the longest period of continuous snow for the metro area occurred in January 1948 (92 hours).

February

The temperature may stay below zero for several days at a time to over a week. High winds (50-100mph) may occur and snows are between 4-12 inches are common. The longest period of snow cover with one inch or more of snow on the ground is 63 days in 1983-84.

March

March weather varies greatly. High winds commonly (50-100mph) have been known to cut powerlines and cause grass fires. Snow events of 4-12 inches are common with periodic blizzards of 2-4 feet. The longest snow-free period of 232 days began in March of 1887.

April

Accumulations of up to 16 inches of snow and winds up to 40-50 mph make blizzards a common occurrence in April. Winds of 112 mph recorded 1999.

May

High winds (70-85 mph), snow (up to 2.5 ft.), rain (up to 3.71 inches), hail (1.75 inches), lightning and tornadoes are common in May. Dry conditions can lead to wildfires.

June

Light snow is possible in the 1st week of June. Heavy rain (1 inch per hour), high winds (63 mph), hail (golf ball size with up to a 6-inch accumulation) and lightning have occurred in June. Temperatures may drop quickly due to fast-moving storms. Temperatures can exceed 100 degrees. In 2012, Westminster experienced five consecutive days >100 F.

July

Westminster experienced 27 days of >90 degrees in 2012. Severe thunderstorms, hail (1.5 inch), lightning, winds in >42 mph and flash flooding has occurred in July.

August

August can be hot and dry with occasional severe thunderstorms (2.68 inches in an hour), wind (60-69 mph) and hail (1.75 inch). Dry thunderstorms which produce lightning and increase the fire hazard are also a possibility.

September

September is characterized by variable weather with rapid drops in temperature, thunderstorms, winds (56 mph) and lightning. Cold fronts and snow (5-10 inches) can occur late in the month. In 2013, flash flooding caused a presidential state of emergency in Lyons, Boulder, Adams, Arapahoe, Broomfield, Clear Creek, Denver, Jefferson, Morgan, Logan, Washington, and Weld Counties.

October

High winds ranging from 50-90 mph have been known to down powerlines. Thunderstorms producing lightning and hail may occur. Heavy rains range between 1-4 inches while snows can range 4-16 inches with rare blizzards of 2-4 feet of snow. Small tornadoes have occurred to the south and west of the metro area. In 1980, a rare tornado touched down in Boulder County causing minor damage.

November

High wind ranging from 50-90 mph are not uncommon and winds of 100-120 mph winds have been recorded in November. Snows ranging from 4-12-inch are common while major snowstorms of 2-4 feet are possible. Fog can limit visibility to as low as 1/8 mile. Historically, the temperatures in Westminster during the month of November range in the 70s and below. However, starting in 2006, temperatures in the 80s have been recorded.

December

Winds in the range of 50-100 mph have been noted in December. Snows generally result in 4-12 inches with heavy snow falls of several feet. Subzero temperatures can last several days to more than a week.

2.3 History:

Prior to 1911, the area that was to become Westminster was inhabited by small herds of buffalo and antelope and was dotted with small marshy ponds. There is strong evidence that the Arapaho Indians maintained a semi-permanent encampment near Gregory Hill. The discovery of gold on Little Dry Creek in 1858 by Jim Baker, encouraged pioneers to settle in Colorado rather than continue to the promise of riches in California. The Homestead Act of 1862 also brought many people from the east to settle in the Colorado Territory.

The first permanent settler to build his home in Westminster was Pleasant DeSpain. In 1870, he built his home on 160 acres of farmland near what is now the intersection of 76th Avenue and Lowell Boulevard. He and his five sons cultivated and harvested grain and the fruit from their apple and cherry orchards.

The village of DeSpain Junction grew into a small farming community and continued to attract new settlers. The merchants that came to the small village reflected the needs of the farmers and ranchers of the area: blacksmith shop, lumber store, and general store. The railroad came to DeSpain Junction in 1881 and a train depot was built.

Many of the homesteaders found farming in Colorado's arid climate to be much more difficult than they had experienced in the Midwest and the East. For this reason, they sold their land to C.J. Harris, a real estate developer from Connecticut who arrived in DeSpain Junction in 1885. He subdivided the farms he bought into smaller tracts of land which he then sold to fruit farmers. By the 1920s, Westminster had become the center for some of the largest apple and cherry orchards in the country. In 1950, Shaffer Orchards, one of these orchards, was sold to make room for the Denver-Boulder Turnpike (US 36). Today, the highway is one of the busiest in the state, contributing to the growth of Westminster and other cities in the northwest quadrant of the Denver metropolitan area.

2.4 Government

The city charter, making Westminster a home rule jurisdiction in both Adams and Jefferson counties was adopted in January 1958. Home rule gave the Westminster City Council the authority to direct its destiny by allowing the issuance of bonds for the financing of utility improvements and by providing the financial control to provide needed capital infrastructure improvements. The city charter also called for a council/manager form of government, vesting the responsibility for managing the city's day-to-day operations in a professional City Manager. Another important provision of the charter called for the election of non-partisan City Council members at-large. This provision has provided Westminster with a City Council that is concerned with the overall welfare of the community, rather than with special interest segments. The city experienced significant growth and economic development from the 1970s through today.

The City Council is the legislative and governing body of the city. The council consists of the Mayor and six councilors. The council adopts laws, ordinances and resolutions that are within its authority. The Mayor is the executive head of the city with an equal vote on the City Council, but no veto power. The Mayor is the conservator of the peace and during emergencies, may exercise the powers to invoke martial law and command the assistance of all able-bodied citizens to aid in the enforcement of the city ordinances.

The City Manager is appointed by the City Council and is the chief administrator of city government. The City Manager is supported by two Deputy City Managers and is responsible for the operations of ten city departments (Community Development, Economic Development, Finance, Fire, General Services, Human Resources, Information Technology, Parks, Recreation and Libraries, Public Works and Utilities and Police). The city also has a Municipal Court with jurisdiction over cases arising from the provisions

contained in the charter and ordinances of the city. The court is presided over by a judge who is appointed by the City Council. The city has about 1,500 employees (City of Westminster).

Public Safety is provided by a police force of 199 sworn and 80.3 professional staff. The Westminster Fire Department is staffed with 144 line fire fighters, 12 administrative and 7 non-sworn staff located throughout the city at six fire stations.

2.5 Economy

2.5.1 Commercial Summary

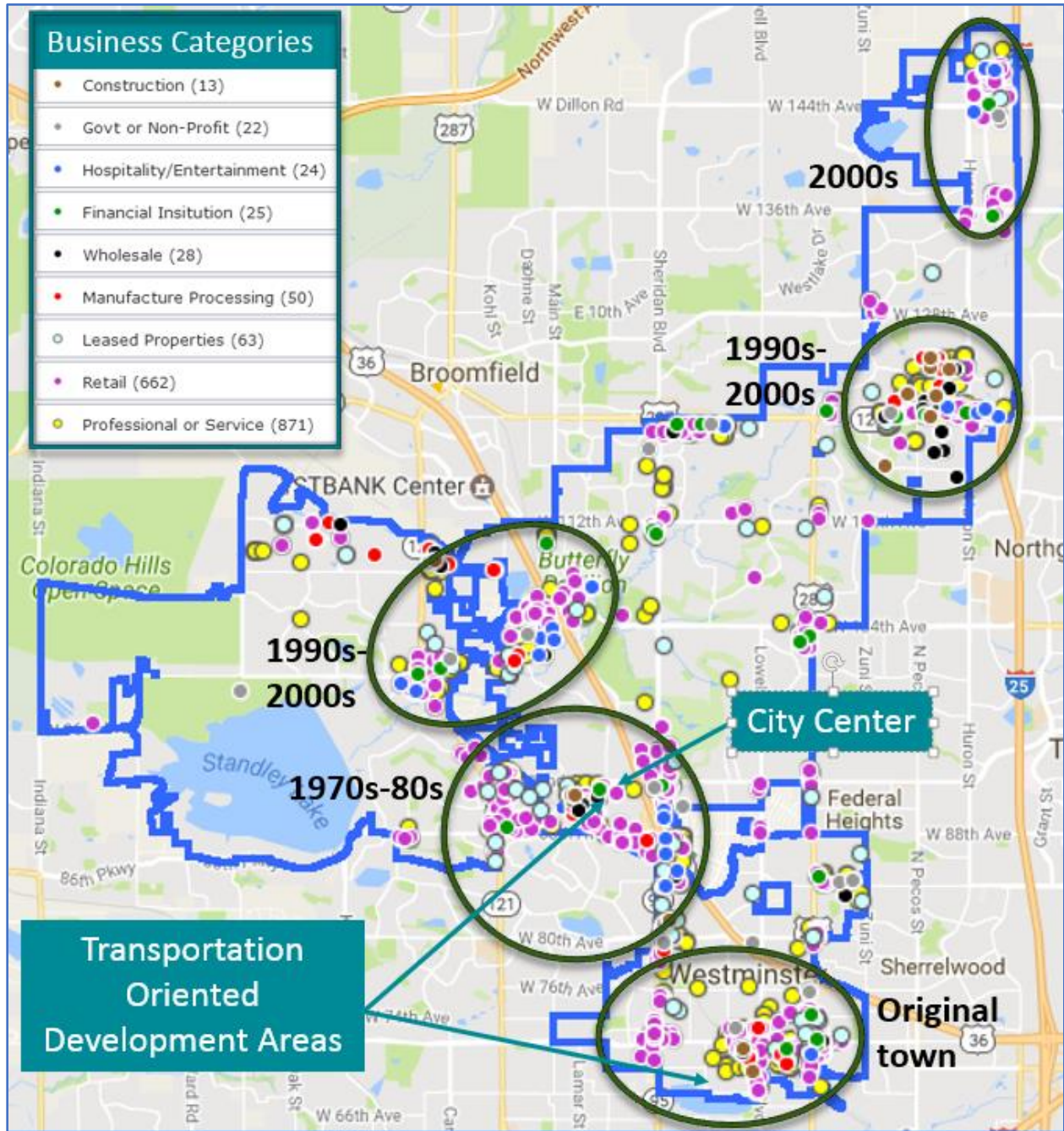
Westminster has experienced dramatic economic development and general growth since the 1970s. The original downtown with retail and some industrial activity is in the south part of the city (along 72nd avenue). As the city developed, four additional economic centers were created to ensure the city's continued economic vitality. The city is currently implementing its plan to create a new mixed-use city center on the 109-acre lot that was previously the location of a mall. This new city center will be located in the area of 88th-92nd Avenues just east of US 36. Transportation Oriented Development (TOD) is also taking a greater role in the development plans of the city. The first mass transit rail station linking Westminster to the Denver metro system was opened in 2016 and future stations are planned along the US 36 corridor. Of the estimated 4,000 businesses in the city, 1,730 businesses are registered with the City Clerk. Of the 1,730 registered businesses, 1,610 are small businesses (< 50 employees). Ball Corporation, Maxar and St. Anthony's North Hospital are our largest employers with each employing over 1,000 employees as shown in **Table 2.1** below. The Butterfly Pavilion and Insect Center is also a popular local attraction. **Table 2.1** below also shows the top ten employers in the city based on the number of employees.

Table 2-1 Top Ten Employers in the City of Westminster

Employer	Business Types	Number of Employees
Ball Corporation	Aerospace and Packaging	3,422
Maxar	Geospatial Technologies	1,183
St. Anthony's North Hospital	Healthcare Provider	1,115
Trimble	Geopositioning Technologies	955
MTech Mechanical Technologies Group	HVAC Systems	542
Epsilon	Marketing Agency	530
ReedGroup	Human Resources Management	500
Tri-State Generation	Electric Energy Wholesaler	480
Bread Financial	Network Credit Authorization	385
Zimvie	Healthcare & Lifesciences	310

Source: City of Westminster, Economic Development Department

Figure 2-2 Business Types and Location in City of Westminster



Source: City of Westminster

According to the Westminster Comprehensive Plan the city’s economic base consists of Aerospace, Business Support Services, Financial Services, Healthcare and Life Sciences, Retail, Hospitality and Entertainment and Technology and Information. These sectors are defined in the City of Westminster’s economic plan as having a “primary importance to Westminster due to their relative concentration compared to the nine-county region and the nation as a whole.” (2040 Comprehensive Plan: Complete Document, 2023). **Table 2.2** compares the industries located in Westminster to the Denver Metro area.

Table 2-2 Comparison of Denver Metro Area and Westminster Employment Composition

Industry	Denver Metro Area	Westminster
Mining and Agriculture	0.9%	0.2%
Construction and Utilities	5.0%	2.5%
Manufacturing	5.8%	6.1%
Wholesale Trade and Transportation	8.1%	5.0%
Retail Trade	10.2%	17.8%
Professional, Technical and Information Services	13.2%	11.4%
Finance, Insurance and Real Estate	7.0%	7.3%
Managerial and Administrative Services	8.9%	9.9%
Health Care, Education and Human Services	12.4%	18.0%
Accommodations, Food Services and Entertainment	10.8%	15.3%
Other Services, except Public Administration	3.1%	2.5%
Public Administration	14.7%	4.0%
Total Employment	100.0%	100.0%

Source: Westminster Comprehensive Plan 2013; Colorado Department of Labor and Employment, Labor Market Information, Quarterly Census of Employment and Wages

Figure 2-3 Key Employers by Industry

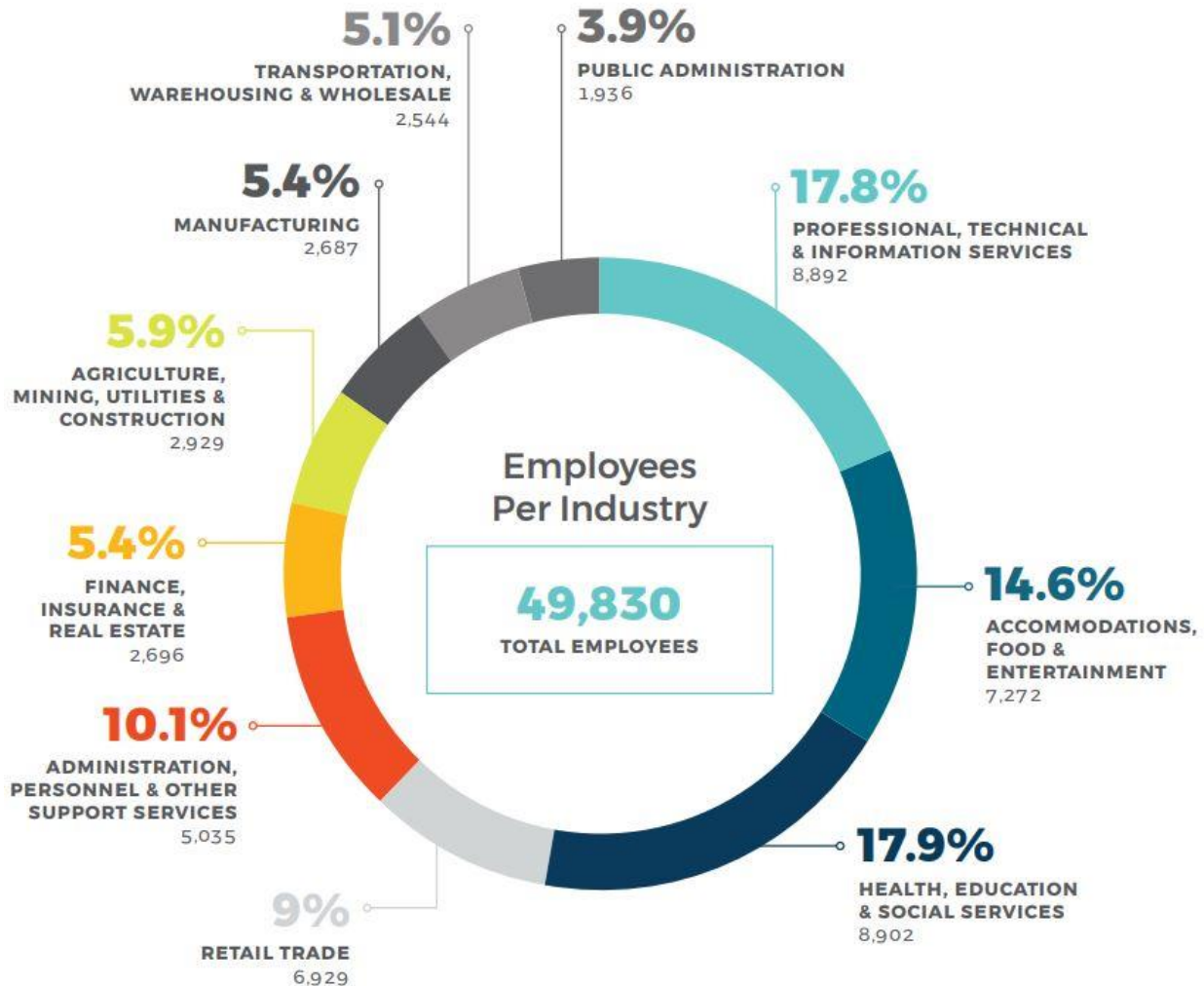


Source: City of Westminster, Economic Development Department

2.5.2 Fiscal Outlook

The City of Westminster is fiscally sound. As of the publishing of the 2023 City Economic Profile, there are 49,830 total employees across all industries in the city. The breakdown of these employees by industry is shown in Figure 2-4 below. Health, Education & Social Services is the highest employed industry within the City of Westminster. This is closely followed by the Professional, Technical & Information Services industry. Third is the retail trade industry which makes up a considerable portion of the total employees per industry.

Figure 2-4 City of Westminster Daytime Employment by Industry



Source: Westminster Daytime Employment by Industry (City Economic Profile 2023)

2.5.3 Recent and Future Development

Westminster is a city of beautiful, safe, well-maintained neighborhoods and destinations with a vibrant, diverse economy, rich and resilient environment, and a strong sense of community and belonging. People choose Westminster because it is a dynamic community with distinct neighborhoods, quality educational opportunities and a resilient local economy that includes: a spectrum of jobs; diverse, integrated housing; and shopping, cultural, entertainment and restaurant options. It embraces the outdoors and is one of the most sustainable cities in America. (City of Westminster Strategic Plan)

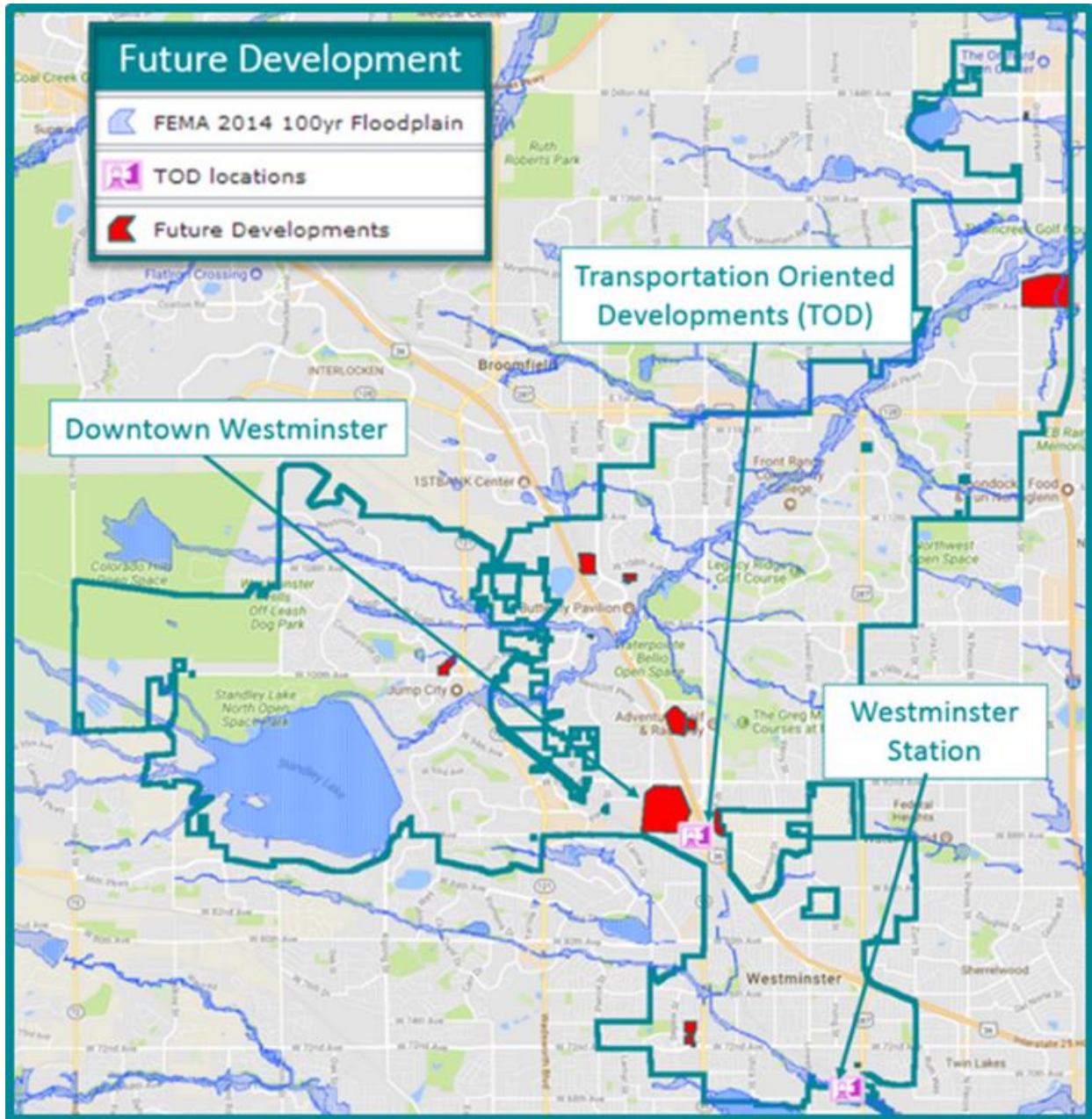
The city is approximately 95% built out, but there are major redevelopment efforts underway. The city's Specific Area Plan identifies two areas as Transit Oriented Development (TOD). Generally, TOD includes dense mixed-use development supported by multimodal infrastructure which provides people with options to walk, bicycle, ride transit or drive.

Westminster Station in south Westminster is served by the B Line Commuter Rail operated by the Regional Transportation District (RTD). The Westminster Station Park RTD B Rail Line opened in July of 2016. It is a nearly 40-acre multi-purpose drainageway, detention storage facility, park, and regional transit-oriented improvement project located in Westminster along Little Dry Creek between Lowell Boulevard and Federal Boulevard. The Westminster Station Drainage Project has received extensive industry recognition including the ACEC 2019 Engineering Excellence Honor Award, CASFM and ACEC's Grand Award & Excellent Award, and the APWA Environmental Award Project of the Year.

Another major source of current and future development is Downtown Westminster. The former site of Westminster Mall, this 105-acre area has been the focus of intensive redevelopment efforts over the past several years to turn the area into a dense, more traditional urban downtown. The entire development is anticipated to incorporate approximately 1.7 million square feet of commercial development and 2,300 new residential units by the early 2030s. This represents a significant potential increase in population, building inventory and value, and exposed assets for the City of Westminster. Downtown Westminster is anticipated to be served by the B Line in the future. Today it benefits from RTD's high frequency Bus Rapid Transit service from the Park and Ride located at US 36 and Sheridan Boulevard.

The city is also committed to providing its residents with a variety of housing options through the development of additional single-family neighborhoods as well as affordable and multi-family communities. Planning for the construction of a new water treatment plant and City Court House is ongoing. The city has a well-established record of considering the potential relationship between our natural hazards and development/re-development.

Figure 2-5 Areas of Future Development in City of Westminster



Source: City of Westminster

The map above (Figure 2-5) show the areas of Westminster that are expected to see development in the future in relation to mapped flood hazards. The City’s 2015 Comprehensive Plan describes the development potential in the City and provides a table that outlines the projected development based on the assumption of the average development intensity for different land use classifications. **Table 2.3** is divided into six development categories: Existing Development – reflects existing development as of August 2013; Current Development – projects currently under construction, approved or proposed as of August 2013; Gross New Development by 2035 – average assumed intensities to vacant lands and underutilized sites that are likely to develop by 2035; Existing Development Lost – existing development that is likely to be lost due to redevelopment of underutilized sites; Net New Development by 2035 – reflects the total of the Existing, Current and Gross New Development in the city; City at 2035 – totaling

Net New Development and Existing Development results in the Comprehensive Plan development potential at 2035. Further discussion of the City's future development, including discussion on the City's redevelopment strategy can be found in 2.6.1. Hazard Related Programs, Policies, Regulations and Codes.

Table 2-3 Projected 2035 Development in City of Westminster

	<i>A. Existing Development 2013</i>	<i>B. Current Development</i>	<i>C. Gross New Development by 2035</i>	<i>D. Existing Development Lost</i>	<i>E. Net New Development by 2035</i>	<i>F. City at 2035</i>
Residential Uses						
Very Low Density (R-1 and R-2.5)	838	147	13		160	998
Low Density (R-3.5 and R-5)	25,665	272	254		526	26,191
Medium Density (R-8)	5,117	99	187		286	5,403
<i>Subtotal Single Family (Detached & Attached)</i>	<i>31,620</i>	<i>518</i>	<i>454</i>		<i>972</i>	<i>32,592</i>
High Density (R-18)	11,710	1,030	176		1,206	12,916
Very High Density (R-36)		465	460		925	925
Residential Units from Mixed Use	1,649	256	4,466		4,722	6,371
<i>Subtotal Multifamily</i>	<i>13,359</i>	<i>1,751</i>	<i>5,102</i>		<i>6,853</i>	<i>20,212</i>
Total Residential Units	44,979	2,269	5,556		7,825	52,804
Population*	109,169					129,423
Non-Residential Uses						
Retail Commercial**	10,443,089	235,029	2,539,300	-963,897	1,810,432	12,253,521
<i>Hotel (square feet)</i>	<i>1,361,660</i>	<i>159,500</i>	<i>403,677</i>		<i>563,177</i>	<i>1,924,837</i>
<i>Hotel (rooms)</i>	<i>1,905</i>	<i>212</i>	<i>577</i>		<i>789</i>	<i>2,694</i>
Service Commercial	177,285	3,500	57,122	-27,961	32,662	209,947
Office/R&D	4,950,686	426,103	4,468,191	-56,038	4,838,256	9,788,942
Flex/Light Industrial	3,283,510	0	1,339,478	-125,296	1,214,182	4,497,692
Total Building Square Feet	18,854,570	664,632	8,404,091	-1,173,192	7,895,532	26,750,102
Employment	39,300					57,300

*Based on a 2035 household size of 2.58, as projected by DRCOG 2035 Metro Vision Plan. Also assumes a 5% residential vacancy rate.

**Includes office uses within retail commercial centers.

Source: City of Westminster, 2015 Comprehensive Plan

2.6 Assessing Capabilities

Identification of loss prevention mechanisms already in place provides an assessment of Westminster's "net vulnerability" to natural disasters and the city's capability to mitigate them. This more accurately focuses the goals, objectives, and proposed actions of this plan. This part of the planning process is referred to as the mitigation capability assessment.

The HMPC took two approaches to conducting this assessment for the city. First, an inventory matrix of common mitigation activities was made. The purpose of this effort was to identify activities and actions that were either in place, needed improvement, or could be undertaken, if deemed appropriate. Second, the HMPC conducted an inventory of existing policies, regulations, and plans. These documents were

collected and reviewed to determine if they contributed to reducing hazard-related losses or if they inadvertently contributed to increasing such losses. This section summarizes the city’s mitigation capabilities currently in place.

This mitigation capability assessment describes the city’s existing mitigation policies, procedures, and plans. **Table 2.4** summarizes the results of the mitigation capability assessment. Excerpts from applicable plans, rules, and regulations follow, which provide more detail on the existing policies related to hazard mitigation and highlight where the city has made efforts above and beyond the standard policies.

Table 2-4 City of Westminster Mitigation Capabilities Overview

Planning and Regulatory Capabilities		
Plans and Regulations	Yes, No, N/A	Comments
Building Codes	Yes	The full set of “I-Codes” are adopted. 2021 code set is set for adoption in 2023.
Building Codes Year	Yes	Currently 2015, working on 2021 set.
BCEGS Rating	Yes	
Capital Improvements Program (CIP) or Plan	Yes	Public Works & Utilities has a CIP; Sustainability Office has a CIP; Stormwater has a CIP plan
Community Rating System (CRS)	Yes	2020 CRS Cycle Verification Activity Report
Community Wildfire Protection Plan (CWPP)	No	Jefferson County 2012 CWPP mentions the city of Westminster, however the focus is primarily on mountain communities
Comprehensive, Master, or General Plan	Yes	Yes, updated in 2023 and cross references the Hazard Mitigation Plan
Economic Development Plan	Yes	
Elevation Certificates	Yes	Staff keeps records of ECs associated with a submitted Letter of Map Amendment (LOMA)
Emergency Operations Plan	Yes	The plan is currently being updated
Erosion/Sediment Control Program	Yes	Stormwater has permit program
Floodplain Management Plan	No	Only city code no formalized plan in stormwater
Flood Insurance Study	Yes	Stormwater in cooperation with Mile High Flood District
Growth Management Ordinance	No	
Hazard-Specific Ordinance or Plan (Floodplain, Steep Slope, Wildfire)	Yes	Drought Management Plan (2019)
National Flood Insurance Program (NFIP)	Yes	Stormwater has this covered under CRS and also in cooperation with Mile High Flood District
Severe Weather Response Plan	Yes – EOP	The tree specific plan will be completed as part of the Urban Forest Management Plan in 2023

Site Plan Review Requirements	Yes	Stormwater has development review standards
Stormwater Program, Plan, or Ordinance	Yes	All of that
Sustainability Plan	Yes	A number of resilience strategies and actions are identified.
Zoning Code or Ordinance	Yes	Title XI of the City of Westminster Code of Ordinances: Land Development and Growth Procedures
Other?	Yes	Colorado Wildfire Risk Assessment Summary Report Westminster Only WUI (2017); Standley Lake Security Assessment (2022)
Administrative and Technical Capabilities		
Administrative and Technical	Yes, No, N/A	Comments
Emergency Manager	Yes	
Floodplain Administrator	Yes	- Andrew Hawthorn – Stormwater Utility Administrator - Heather Otterstetter – Stormwater Coordinator
Community Planning:		
– Planner/Engineer (Land Development)	Yes	Community Development
– Planner/Engineer/Scientist (Natural Hazards)	Yes	Community Development
– Engineer/Professional (Construction)	Yes	Community Development
– Resiliency Planner	Yes	Sustainability Office can provide programmatic support
– Transportation Planner	Yes	
Full-Time Building Official	Yes	
GIS Specialist and Capability	Yes	
Grant Manager, Writer, or Specialist	Yes	
Housing Authority	No	
Warning Systems: (list the hazards each system is used for)	Yes	See descriptions of Lookout Alert, Cable Television Interrupt, and Emergency Alert System below
– Sirens	No	
– Reverse 911	Yes	All hazards
– IPAWS/Wireless Emergency Alerts (WEA)	Yes	
– Opt-In Notifications (CodeRed, Everbridge, etc.)	Yes	Lookout Alerts, Clear Creek CodeRed Call-Down
– Other system	Yes	Social media, web page
Other?	Yes	Mile High Flood District early flood warning
Nongovernmental Organizations (NGOs)		
Nongovernmental Organizations (NGOs)	Is there a local chapter? Y/N	Comments
American Red Cross	Yes	
Chamber of Commerce	Yes	
Community Organizations (Lions, Kiwanis, etc.)	Yes	
Environmental Groups	No	
Homeowner Associations	Yes	
Neighborhood Associations	Yes	
Salvation Army	Yes	
Veterans Groups	No	

Other?	Yes – Formal and Informal Community Organizations	Community Reach (mental health), Growing Home (housing assistance), Hope House, Almost Home, Beyond Home, religious organizations, Precious Child (donations), school districts, COVOAD, Westminster Cares (faith-based food and housing assistance).
Financial Capabilities		
Financial Capabilities	Is this available for use in the city?	Has the City used this capability in last 5 years?
Ability to fund projects through Capital Improvements funding	Yes	Yes – Sustainability Office, Fire Dept., Stormwater, etc.
Ability to incur debt through general obligation bonds	Yes	Limited to Certificates of Proceed
Ability to incur debt through private activities	No	
Ability to incur debt through special tax bonds	Yes	No – requires ballot initiative
Authority to levy taxes for a specific purpose with voter approval	Yes	Yes
Authority to withhold spending in hazard-prone areas	No	
Community Development Block Grants	Yes	Yes
FEMA Hazard Mitigation Assistance grants	Yes	HMP-Update, 2020
FEMA Public Assistance funds	No	
Stormwater Service Fees	Yes	Yes
System Development Fee	Yes	Tap fees
Utility fees (water, sewer, gas, electric, etc.)	Yes	Water & sewer fees
Other?		
Education & Outreach Programs		
Education & Outreach Programs	Yes, No, N/A	Comments
Ongoing public education programs (fire safety, responsible water use, household preparedness, etc.)	Yes	Individual, home, and business preparedness are promoted on social media, the City web page, numerous special events, and group presentations; water conservation on the City web page and promoted similarly as above
Local citizen groups that communicate hazard risks	Yes	The EMC maintains a list of residents who have expressed an interest in mitigation and preparedness.
Firewise or other fire mitigation program	Yes	Firewise is promoted through social media, special events, and various public outreach
National Weather Service StormReady	No	Not currently being promoted
Ongoing emerald ash borer awareness	Yes	EAB information promoted via social media, City webpage, utility billing flyers. Cohesive EAB messaging push will take place in spring 2023.
Neighborhood outreach	Yes	The City will implement a comprehensive neighborhood outreach program in 2023 and include EMC as a vital component.

2.6.1 Hazard Related Programs, Policies, Regulations and Codes

The City of Westminster has several policies, regulations and codes that guide how the city manages development of hazard-prone areas. Many of these policies have multiple objectives. Those that are directly related to reducing losses to future development or the protection of critical facilities and/or vulnerable populations are summarized here.

Westminster Comprehensive Plan

The Westminster 2040 *Comprehensive Plan*, updated and adopted in March 2023, guides the future development of the city. The intent of the Comprehensive Plan is to guide decisions to support a thriving and healthy community, manage growth, and foster great neighborhoods. One of the primary themes of the plan is Resilience, which directly references this HMP and recognizes the need for the city to proactively plan for natural hazards. The Plan recognizes the influences the floodplains and topography, have over land use patterns. **Chapter 2.0 *Utilities and Resources*** speaks to the city's water supply both current and future, the wastewater system, stormwater quality in terms of stormwater management and flood control, and public safety.

The Plan established guiding principles that build on the city's vision statement. These principles include the following:

- Distinctive city with a Strong Identity
- Vibrant Community with a Diverse, Healthy Economy
- Comprehensive, Integrated Parks and Open Space System
- Well-Designed, Attractive Neighborhoods
- Balanced Housing Mix
- Mixed Use and Transit-Oriented Development
- Balanced Transportation System
- Environmental Stewardship and Water Resource Management
- Safe and Healthy Communities

Fire and Emergency Medical Service Master Plan

An update to the Fire and Emergency Medical Service Master Plan was completed in 2006. The fire department is undergoing an accreditation process which involves conducting a community risk assessment, addressing those risks and long-term planning. The City of Westminster Fire Department (WFD) is responsible for the protection of life and property through fire prevention, education, fire suppression, and emergency medical and rescue services, as well as emergency management. The Fire Department has six fire stations strategically located around the city:

Each station operates 24 hours per day, seven days per week and is equipped to respond to fire, medical, and other emergencies. Medical calls accounted for 70 percent of the 8,125 calls for service in 2017.

The master plan service standards are as follows:

- Respond with basic life support within six minutes 80 percent of the time.
- WFD strives to maintain a five-minute average response time to all emergency calls, and responding to 80 percent of all calls within six minutes.
- The following seven philosophies provide general direction when establishing goals and objectives for fire protection in the City of Westminster:
- Shared Responsibility for Fire Protection—the city emphasizes private sector self-protection through code regulations and design incentives. Installation of automatic fire sprinkler systems is now required by ordinance for many uses.
- Balance between Built-In Fire Protection and Public Fire Protection Service.
- Municipal fire protection requires a balance between services provided by the city through fire stations, apparatus, and personnel and that provided by built-in automatic fire systems. Automatic systems offer

a high degree of protection from fire originating in those protected properties. City-provided protection supplements the built-in systems and is designed to handle fires in non-protected buildings, outside fires, medical emergencies, and non-fire emergencies and events.

- **Generalist Theory of Operation**—The Fire–Rescue Department believes that each fire apparatus should have diverse equipment and that the firefighters should be generalists rather than specialists. Every front-line fire truck has firefighting and rescue equipment along with emergency medical supplies. Each firefighter must pass a comprehensive training program that supports that generalist approach. State of Colorado emergency medical technician certification is required, and every firefighter’s training includes firefighting, hazardous materials response, and training for rescues involving vehicle accidents, fires, water, and ice incidents.
- **Basic Level of Emergency Medical Service**— Westminster Fire Department provides basic and advanced life support services. The EMS delivery system is a two-tiered system. All medical and trauma related alarms require an ambulance and engine response. EMT’s and paramedics respond on fire apparatus along with a WFD ALS ambulance which is often staffed with two paramedics.
- **Specialist Capabilities**—In addition to the traditional general fire and emergency medical capabilities, the Fire–Rescue Department provides services that are more specialized:
 - The Water Rescue Team provides swift water rescue and water rescue/recovery services for accidents in lakes and ponds.
 - The Hazardous Materials Team operating through a regional team helps to reduce the threat or release hazardous substances.
 - The Wildland Fire Team provides response capability to wildland fires that occur within the City of Westminster, to other Colorado jurisdictions through a State-wide mutual aid agreement, and to other States as designated through Federal wildland management plans.
- **Training**—The Fire/Rescue Department offers a wide variety of services to the citizens of Westminster. To maintain an adequate level of proficiency in many areas of emergency service, the department conducts extensive training in all service areas including firefighting, fire prevention, emergency medical care, hazardous materials, rescue and public education. Joint training exercises are conducted with other agencies.
- **Impact of Infill**—city fire stations are strategically located to meet the emergency response service standards.

Anticipated infill projects typically utilize the urbanized mixed-use concept where many different uses, i.e., business, commercial and residential are intertwined within the project design concept. Mixed-use developments represent a unique challenge from both a fire protection and EMS services perspective. Proposed population densities potentially add to a fire protection and EMS delivery system that is not designed for this potential impact. Limited access points, reduced street widths, lack of emergency apparatus/vehicle staging and deployment opportunities and traffic control features present challenges to responding emergency units. Changes in building sizes and configurations, internally and externally, present challenges unique to each infill project. A close working relationship with Community Development has and will continue to serve the community well in coordinating the Fire Department’s response to challenges presented by future infill projects.

West Nile Virus Management Plan

The City of Westminster has had a comprehensive mosquito management plan since 1986. With the onset of West Nile Virus this plan was adapted to confront this serious disease. West Nile virus is a disease that can be transmitted to humans by mosquitoes. It has been common in Africa, west Asia and the Middle East for decades. It first appeared in the US in 1999 in New York. It has since traveled westward across the country and now is in Colorado. Mosquito season in Colorado starts in the spring and ends in mid-September. The West Nile virus is carried long distances by infected birds and then spread locally by mosquitoes that bite these birds. Infected mosquitoes can then bite and pass the virus to humans and animals, primarily birds and horses. There is a vaccine for horses, but none for humans. House pets do not spread the illness. Health departments across the state are closely monitoring human and horse illnesses and tracking the virus by testing dead birds and trapping mosquitoes. Westminster uses the services of Colorado Mosquito Control, Inc. to provide an integrated pest management (IPM)

program that effectively controls all aspects of the mosquito lifecycle. All areas of the city, both public and private, are managed through this program.

Emergency Plan and Management Systems

The purpose of the EPMS is to delineate task assignments and responsibilities for the operational actions that will be taken prior to, during and following an emergency or disaster affecting local government to alleviate suffering, save lives and protect property. As described in the plan, the city operates and maintains compliance with the National Incident Management System (NIMS).

Emergency Warning and Evacuation System

The existing 911 database of telephone numbers and addresses is used in combination with detailed maps to help determine the geographic boundaries of an impacted area. The system can make up to 1,200 calls per minute. It is designed to deliver recorded information to endangered people in advance of a disaster. Messages can be delivered in various languages. They can also be sent to pagers and the Emergency Alert System.

Lookout Alert

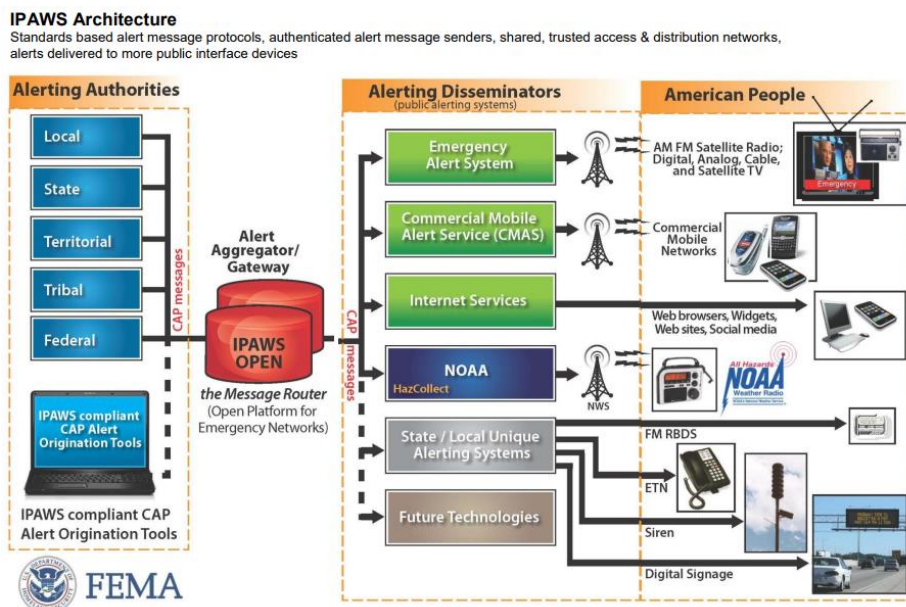
Westminster Police Dispatch is the lead Public Safety Answering Point (PSAP) for emergency mass notifications using the LookoutAlert system. Weather alerts are routinely routed through LookoutAlert, and Incident Command may also request an emergency alert to the public. Notifications sent via LookoutAlert are intended to provide timely warning and guidance to enable the public to take protective actions (usually shelter-in-place or evacuate). LookoutAlert can also provide an “all-clear” message once the danger has passed.

LookoutAlert enables Dispatch to send emergency notifications to all landlines in Westminster. Residents are also encouraged to opt-in by registering mobile phones, VOIP, and other devices to ensure the broadest alerting coverage. Geofencing can be used to limit notifications to specific areas. Polygons to support geofencing are available through Westminster’s Geographic Information Systems (GIS). Geofences can also be created as needed in LookoutAlert. Dispatch is also certified to use the national Integrated Public Alerting and Warning System (IPAWS) which supports emergency alerting over all available platforms (see below).

The PSAPS and government agencies in Jefferson and Broomfield counties use LookoutAlert for emergency notifications. This includes all incorporated Westminster. The PSAPS and government agencies in Adams County use CodeRed for emergency notifications. Since some Westminster postal addresses are in unincorporated Adams County, residents may need guidance about whether to sign up for LookoutAlert or CodeRed.

Neighboring PSAPS coordinate public alerts as needed, and residents may receive multiple notifications depending on their location and registered devices.

Rave and Lookout alerts are based on pre-loaded databases. Rave pulls employee work



email addresses, telephone numbers, work assignment, and work location from JD Edwards. Published landline numbers are loaded into LookoutAlert and updated annually. Both systems offer employees and residents the opportunity to create and manage profiles that include personal mobile devices and email addresses. Employee and resident reluctance to provide preferred contact information can lead to communications gaps (we cannot contact you if you do not provide your contact information).

IPAWS is a federal program that integrates the Emergency Alert System, the National Warning System, Wireless Emergency Alerts, and the NOAA Weather Radio System to provide information via television, radio, telephone, mobile phones, sirens, the internet, and digital signage. Although the public is encouraged to sign up for notifications, IPAWS leverages all forms of broadcast communications and can force notifications on wireless networks. IPAWS-certified PSAPS can send messages over IPAWS, but the alerting area may be much broader than intended.

Cable Television Interrupt

Programming on all television channels can be immediately interrupted for any emergency that has a significant effect on public safety or for any unusual situation that requires evacuation. The screen can be blanked out and the emergency message transmitted.

Emergency Alert System

Emergency Alert System (EAS) is a national public warning system that requires broadcasters, cable television systems, wireless cable systems, satellite digital audio radio service (SDARS) providers, and direct broadcast satellite (DBS) providers to provide the communications capability to the President to address the American public during a national emergency. The system also may be used by Westminster to deliver important emergency information notifications.

NOAA Weather Radio All Hazards

NOAA Weather Radio All Hazards is a service of the National Oceanic and Atmospheric Administration (NOAA). It provides continuous broadcasts of the weather information directly from National Weather Service offices. Weather messages are repeated every four to six minutes and are routinely revised every two to three hours, or more frequently if needed. The broadcasts are tailored to weather information needs of people within the receiving area. During severe weather, National Weather Service forecasters can interrupt the routine weather broadcasts and substitute special warning messages. Special weather radio receivers are available for purchase at local electronics stores or online. NOAA classifies coverage in Westminster as reliable.

City of Westminster Code of Ordinances

The city is a municipal corporation duly organized and existing under the laws of the State of Colorado. Westminster is a home rule city and adopted a charter pursuant to Article XX of the Constitution of the State of Colorado on October 30, 1917. The city's Code of Ordinances, Title XI regulates includes several chapters that regulate land development and growth procedures. Several of these regulations relate to hazard mitigation including:

- Comprehensive Planning & Growth Management – Chapter 3
- Zoning – Chapter 4
- Site Development Standards – Chapter 7
- Floodplain regulations – Chapter 8
- Building Code – Chapter 9
- Fire Code – Chapter 10

The City of Westminster zoning code does not include any hazard overlays. The City's floodplain regulations establish development restrictions and requirements within the City's floodplain and for compliance with the NFIP. The city currently has adopted the 2015 International Building Codes (IBC) with amendments to various sections detailed in Chapter 9, Sections 11-9-5 through 11-9-13 of the Westminster Code of Ordinances. As noted in the Mitigation Action Plan, the City of Westminster intends to update the

building codes and adopt the 2021 building and energy codes. These codes will make new buildings safer and more energy efficient. In addition, provisions in the code will require that buildings be constructed to accommodate future installation of solar panels, batteries and electric vehicle charging stations.

NFIP and CRS Program Participation

The city joined the NFIP on September 30, 1988, which allows private property owners to purchase affordable flood insurance and enables the community to retain its eligibility to receive certain federally backed monies and disaster relief funds. The city's Public Works and Utility Department handles the city's water distribution, wastewater systems, and floodplain management. The city has two floodplain administrators who handle the provisions of the NFIP and ensure compliance: Andrew Hawthorn is the Stormwater Utility Administrator and Heather Otterstetter is the Stormwater Coordinator. Over 70% of the City's floodplains are located within zoned Open Space. Development is rarely allowed in a mapped floodplain if it is, it is only with a CLOMR/LOMR and Army Corp of Engineers approval. The City does not allow new residential structures to be built in a mapped floodplain. The City also requires that any nonconforming structure that is destroyed by any means, including floods, to the extent that the cost of restoration would equal or exceed 50 percent of the market value of the structure before the structure was damaged, the following regulations shall apply:

1. If the nonconforming structure is in the floodway, the structure may be rebuilt; however, it shall not be expanded, changed, enlarged or altered in any way that would create an obstruction to water flow greater than that which existed before damage to the structure occurred. Upon reconstruction, nonresidential and residential structures shall be elevated two feet above the 100-year flood elevation, as indicated in the appropriate flood insurance study. As an alternative nonresidential facilities can be completely flood proofed two feet above the 100-year flood elevation, as indicated in the appropriate flood insurance study. The walls and basement floor shall be completely flood proofed and they shall be built to withstand lateral and uplift water pressure.
2. If the structure is located in the flood storage area, it may be reconstructed, provided nonresidential and residential structures are elevated two feet above the 100-year flood elevation, as indicated in the appropriate flood insurance study.
3. As an alternative for nonresidential structures only, the structure, including utility and sanitary facilities, can be completely flood proofed two feet above the 100-year flood elevation, as indicated in the appropriate flood insurance study. The walls and basement floor shall be completely flood proofed and they shall be built to withstand lateral and uplift water pressure.
4. If any manufactured home or home park is destroyed by any means such that the cost of restoration would exceed 50 percent of the market value of the structure prior to damage, then such manufactured home or manufactured home park shall not be rebuilt if it is located in the floodway and, if it is located in the flood storage area, it shall be rebuilt in conformance with this ordinance.

The city also participates in the NFIP's Community Rating System (CRS). The CRS is a voluntary program for NFIP-participating communities. It provides flood insurance discounts to policyholders in communities that provide extra measures of flood protection above the minimum NFIP requirements. The City of Westminster entered the CRS on October 1, 1991. The city has a Class 6 rating which provides a 20 percent discount for flood insurance policyholders within a special flood hazard area (SFHA) and a 10 percent discount for those outside of an SFHA. The City of Westminster is mapped within the FEMA NFHL. Developing in the floodplain is sternly advised against and if it occurs permitting is required.

Economic Development and Redevelopment Strategies

The City of Westminster economic development strategy focuses on maintaining a vital, diverse and sustainable economy. The strategy looks at capturing industries and growing small local businesses throughout the city over the next 20 years. The strategy focuses on infill and redevelopment. The redevelopment strategy, which is implemented by the Westminster Economic Development Authority, focuses on and oversees redevelopment within and throughout the city. The areas of the city with strong economic and redevelopment emphasis include:

- Area around current St. Anthony North Hospital
- Areas along the Wadsworth Corridor
- Former AT&T manufacturing facility
- The Mandalay Urban Renewal District
- The North Huron Urban Renewal District
- The South Sheridan Urban Renewal District
- The South Westminster Urban Renewal District
- The Westminster Center East Urban Renewal District
- The Westminster Center Urban Renewal District

2.6.2 Opportunities for Enhancement

Based on the capability assessment, the City of Westminster has several existing mechanisms in place that already help to mitigate hazards, including numerous planning tools such as the city’s Lookout Alert program and Comprehensive Plan, and many available funding mechanisms. The 2023 update provided the City an opportunity to review and update the capabilities currently in place to mitigate hazards. This also provided an opportunity to identify where capabilities could be improved or enhanced. Specific opportunities could include the update or development of following plans, which should also cross reference this HMP:

- Explore possible funding of hazard mitigation activities in the Capital Improvement Plan update.
- Become a StormReady certified community.
- Explore the feasibility of improving the City’s CRS rating (see Section 2.6.1).
- Improve coordination and collaboration with County and regional entities.

2.6.3 Hazard Management Capabilities of Other State and Regional Agencies

Colorado Water Conservation Board

The Colorado Water Conservation Board (CWCB) is an agency of the State of Colorado. The CWCB Flood Protection Program is directed to review and approve state-wide floodplain studies and designations prior to adoption by local governments. The CWCB is also responsible for the coordination of the National Flood Insurance Program (NFIP) in Colorado and for providing assistance to local communities in meeting NFIP requirements. This includes CWCB prepared or partnered local floodplain studies. The CWCB has promulgated new floodplain rules and regulations that became effective on January 14, 2011. Increased protection for public health, safety and welfare in the state is the primary reason for updating Colorado’s floodplain rules. The CWCB’s rules aim to reduce flood losses through sound flood protection actions, which are implemented at the local level and supported by State and Federal programs. Key provisions of the new floodplain rules include: higher freeboard for structures, a 0.5-foot floodway and additional protection for “critical facilities” in the 100-year floodplain.

Mile High Flood District

The Mile High Flood District (MHFD) was established by the Colorado legislature in 1969 to help local governments in the Denver metropolitan area with multi-jurisdictional drainage and flood control problems. The MHFD covers 1,608 square miles and includes all or parts of 34 incorporated cities and towns, including the City of Westminster. There are about 1,600 miles of “major drainageways” that are defined as draining at least 1,000 acres. The population of the district is approximately 2.8 million.

The district provides services related to floodplain mapping; flood safety and early warning; new developments; and planning, design, construction and maintenance of watershed and stream improvements. The district helps local governments in maintaining and preserving floodways and floodplains in areas eligible for MHFD maintenance. MHFD maintenance is limited to facilities that are publicly owned or are in a public drainageway easement and are categorized into routine, restoration and rehabilitation projects. Routine maintenance consists of scheduled mowing and trash and debris pickup on major drainageways during the growing season. It may also include small revegetation efforts and limited weed control. Restoration projects address local erosion problems, existing structure repair, detention pond restoration, tree thinning, removal of sediment deposits from flood control facilities and revegetation work. The district also assists with developing community flood warning capabilities, including

implementation of early flood detection systems and providing early notifications concerning potential and imminent flood threats. In the past, the city and MHFD have worked together to map the floodplains throughout Westminster. Currently, they are working as partners to complete a study on the drainage capacity of existing infrastructure to help determine maintenance needs throughout the city.

Colorado Division of Homeland Security and Emergency Management

The Colorado Division of Homeland Security and Emergency Management (DHSEM) is responsible for the state's comprehensive emergency management program, which supports local and state agencies. Activities and services cover all aspects of emergency management. Assistance to local governments includes financial and technical assistance as well as training and exercise support. Services are made available through local emergency managers supported by CO OEM staff assigned to specific areas of the state. DHSEM also provides guidance and technical assistance on mitigation grant applications.

Colorado Geological Survey

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

Colorado Department of Water Resources – Office of State Engineer

The Colorado Division of Water Resources (DWR), also known as the Office of the State Engineer, administers water rights, issues water well permits, represents Colorado in interstate water compact proceedings, monitors streamflow and water use, approves construction and repair of dams and performs dam safety inspections, issues licenses for well drillers and assures the safe and proper construction of water wells, and maintains numerous databases of Colorado water information. As it relates to hazard mitigation it is the department's mission to ensure public safety through safe dams and properly permitted and constructed water wells.

The Dam Safety branch is responsible for the safety of all existing dams in the state of Colorado. The branch carries out two principal duties of the State Engineer: to determine the safe storage level of the reservoir dams in the state and to approve the plans and specifications for the construction and repair of Jurisdictional dams. Dam Safety engineers regularly inspect jurisdictional dams throughout the state.

Whenever there is a dam emergency, dam owners are requested to immediately follow their *Emergency Action Plan*, notify the local enforcement authority (ex. sheriff or 911), notify the Colorado Division of Emergency Management and notify the State of Colorado's Dam Safety Branch.

Colorado Department of Transportation

The Colorado Department of Transportation (CDOT) conducts planning and projects that relate to hazard mitigation. These include design of bridges to withstand scouring and convey flood flows in addition to rockfall hazard identification and mitigation along the State's highway system. CDOT employs message signs, road closure devices, and radio advisories to warn motorists of dangerous driving conditions and road closures due to severe weather or rockfall incidents. CDOT has developed a US 36 Traffic Incident Management Plan for the Boulder Turnpike.

3 PLANNING PROCESS

Planning Requirements

Requirements §201.6 (b) and §201.6(c)(1):

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 shall 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 and nonprofit interests to be involved in the planning process; and*
- 3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.*

[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.

3.1 Background on Mitigation Planning in The City Of Westminster

The planning process and development of the City of Westminster Hazard Mitigation Plan has its roots in the 2003 Denver Regional Council of Governments Hazard Mitigation Plan. The city participated in the regional plan and several of the actions listed in the regional plan were identified by the HMPC in the 2010 Natural Hazard Mitigation Plan as actions and strategies that influenced or were incorporated into city planning efforts or projects. The city determined that a single jurisdictional hazard mitigation plan would be beneficial to the community and began the planning process with meetings and activities starting in 2009. The first version of the plan was approved by FEMA in 2010. The plan underwent comprehensive updates in 2017-2018 to comply with the five-year update cycle required by DMA 2000. The city has worked with a consultant, WSP (formerly Wood plc) to facilitate and develop the plan. WSP's role was to:

- Ensure compliance with the Disaster Mitigation Act of 2000 (DMA) and Community Rating System
- Meet the DMA requirements as established by federal regulations and following the Federal Emergency Management Agency's (FEMA) planning guidance
- Facilitate the planning process
- Identify the data requirements that HMPC participants could provide and conduct the research and documentation necessary to augment that data
- Produce the draft and final plan documents
- Coordinate the Colorado Division of Emergency Management and Homeland Security and FEMA Region VIII plan reviews.

3.2 Plan Selection Review and Analysis – 2023 Update

This hazard mitigation plan update involves a comprehensive review and update of each section of the 2010 plan and includes an assessment of the success of the city in evaluating, monitoring and implementing the mitigation strategy outlined in the initial plan. Since the original development of the plan, FEMA guidance for local hazard mitigation plans has been refined and updated. The process followed to review and revise chapters of the plan during the 2023 update is detailed in **Table 3.1**. As part of this plan update, all sections of the plan were reviewed and updated to reflect new data on hazards and risk, the risk analysis processes, capabilities, participating stakeholders and mitigation strategies. Only the information and data still valid from the 2018 plan was carried forward as applicable to this LHMP update.

Table 3-1 2023 Plan Update Summary of Changes by Chapter

Plan Section	Update Review and Analysis
1.0 Introduction	<ul style="list-style-type: none"> Updated language to describe purpose and requirements of the City of Westminster Local Hazard Mitigation Plan update process.
2.0 Community Profile	<ul style="list-style-type: none"> Updated language and information in community profile based on recent data including the City’s 2023 Economic Profile Included updated version of capabilities assessment.
3.0 Planning Process	<ul style="list-style-type: none"> Described and documented the planning process for the 2017-2018 update, including coordination among agencies and integration with other planning efforts. Described any changes in participation in detail. Described 2022-2023 public participation process.
4.0 Risk Assessment	<ul style="list-style-type: none"> Updated hazards identified to include wind-driven fire hazards. Updated risk assessment for existing and additional hazards. Incorporated information from various sources including the National Centers for Environmental Information database on weather events Referenced existing planning mechanisms detailed in Section 7.2.3 for sources of information Included various studies and reports including the Future Cost Explorer tool
5.0 Mitigation Strategy	<ul style="list-style-type: none"> Updated Chapter 5 based on the results of the updated risk assessment, completed mitigation actions, and implementation obstacles and opportunities since the completion of the previous plan.
5.1 Goals and Objectives	<ul style="list-style-type: none"> Reviewed goals and objectives to determine if they are still representative of the city’s mitigation strategy. Revised the goals and objectives based on HMPC input. Goals and objectives of existing city plans were referenced for coordination with HMP goals
5.2 Identified Mitigation Measures and Alternatives	<ul style="list-style-type: none"> Revised to include more information on the categories of mitigation measures (structural projects, natural resource protection, emergency services, etc.) and how they are reviewed when considering the options for mitigation. Included more information on how actions are prioritized.
5.3 Mitigation Actions	<ul style="list-style-type: none"> Reviewed mitigation actions from the 2018 plan and developed a status report for each; identified if action has been completed or is ongoing. Identified “Progress on Previous Mitigation Actions” to highlight positive movement on actions identified in 2018 plan. Identified and detailed new mitigation actions proposed by the HMPC. Identified projects that will be likely candidates for pre-vs. post-disaster mitigation funding. Referenced existing city plans and budgets for potential funding sources
6.0 Plan Adoption	<ul style="list-style-type: none"> No changes to section but updated with resolution in Appendix C.
7.0 Plan Implementation and Maintenance	<ul style="list-style-type: none"> Reviewed and updated procedures for monitoring, evaluating, and updating the plan. Revised to reflect current methods. Updated the system for monitoring progress of mitigation activities by identifying additional criteria for plan monitoring and maintenance. Lists the various existing plans and studies which were reviewed, referenced, and/or incorporated into the plan update

Plan Section	Update Review and Analysis
Appendices	<ul style="list-style-type: none"> • Appendix A – References • Appendix B – Planning Process • Appendix C – Adoption Resolution • Appendix D – Mitigation Categories, Alternatives, and Selection Criteria

3.3 Local Government Participation

The DMA planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process
- Detail areas within the planning area where the risk differs from that facing the entire area
- Identify specific projects to be eligible for funding
- Have the governing board formally adopt the plan.

For the City of Westminster’s HMPC committee members, “participation” meant:

- Attending and participating in the HMPC meetings
- Providing available data requested of the HMPC coordinator or WSP’s project manager
- Providing or updating hazard profiles and vulnerability details specific to the city
- Developing or updating the local mitigation strategies (action items and progress to date)
- Reviewing and commenting on the plan drafts
- Advertising, coordinating, and participating in the public input process
- Coordinating the formal adoption of the plan by the City of Westminster’s council.

The city’s Emergency Management Coordinator took the lead on the plan’s initial development in 2010 as well as the 2017-2018 update. This pattern continued in regard to the 2023 plan update as well.

3.4 The 10-Step Planning Process

WSP established the planning process for updating the City of Westminster’s plan using the DMA planning requirements and FEMA’s associated guidance. The original FEMA planning guidance is structured around a four-phase process:

- Organize Resources
- Assess Risks
- Develop the Mitigation Plan
- Implement the Plan and Monitor Progress

FEMA’s March 2013 Local Mitigation Planning Handbook recommends a nine-step process within the original four-phase process. Into this four-phase process, WSP integrated a more detailed 10-step planning process used for FEMA’s Community Rating System (CRS) and the Flood Mitigation Assistance program. Thus, the modified 10-step process used for this plan meets the funding eligibility requirements of the Hazard Mitigation Assistance grants (including Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, Flood Mitigation Assistance), Community Rating System, and the flood control projects authorized by the US Army Corps of Engineers (USACE). **Table 3.2** summarizes the four-phase DMA process, the detailed CRS planning steps and work plan used to develop the plan, the nine handbook planning tasks from FEMA’s 2013 Local Mitigation Planning Handbook, and where the results are captured in the Plan.

Table 3-2 Mitigation Planning Process Used to Update the Plan

FEMA four Phase Guidance	Community Rating System (CRS) Planning Steps (Activity 510) and WSP Work Plan Steps	FEMA Local Mitigation Planning Handbook Tasks (44 CFR Part 201)	Location in Plan
Phase I: Organize Resources	Step 1. Organize Resources	1: Determine the Planning Area and Resources	Chapters 1, 2 and 3
		2: Build the Planning Team 44 CFR 201.6(c)(1)	Chapter 3, Section 3.1
	Step 2. Involve the public	3: Create an Outreach Strategy y 44 CFR 201.6(b)(1)	Chapter 3, Section 3.1, 3.3.1
	Step 3. Coordinate with Other Agencies	4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)	Chapter 3, Section 3.1, 3.3.1 Chapter 4, Section 4.4
Phase II: Assess Risks	Step 4. Assess the hazard	5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)	Chapter 4, Sections 4.1-4.3
	Step 5. Assess the problem		Chapter 4, Sections 4.3
Phase III: Develop the Mitigation Strategy	Step 6. Set goals	6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)	Chapter 5, Sections 5.1 and 5.2
	Step 7. Review possible activities		Chapter 5, Section 5.3
	Step 8. Draft an action plan		Chapter 5, Section 5.4
Phase IV: Adopt and Implement the Plan	Step 9. Adopt the plan	8: Review and Adopt the Plan 44 CFR 201.6(c)(3)	Chapter 6, Appendix A
	Step 10. Implement, evaluate, revise	7: Keep the Plan Current	Chapter 7
		9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)	Chapter 7

The planning process that follows describes the process which WSP and the city used in the 2022-2023 plan update.

3.4.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

With the City of Westminster's commitment to participate in the DMA planning process, WSP worked with the city's Emergency Management Coordinator to establish the framework and organization for development of the plan. The HMPC, which was comprised of key city stakeholders and other local government representatives, developed the plan with leadership from the City of Westminster's Emergency Management Coordinator and facilitation by WSP **Appendix B: Planning Process**, contains the sign-in sheets from each HMPC meeting, highlighting which members participated in each meeting. Among the participants was the City's Principal Planner, who is responsible for the land use and comprehensive planning in the City of Westminster. The table below list the participants comprising the City of Westminster HMPC:

Table 3-3 City of Westminster HMPC Members

	Position	Department
Seth Plas*	Capital Projects Administrator	Community Development
Paul Schmiechen*	Chief Sustainability Officer	City Manager's Office
Kit Redmer*	Community Outreach Liaison	City Manager's Office
Bob Hose*	Deputy Chief	Fire Department
Stephanie Troller	Economic Resilience Manager	Economic Development
Greg Moser*	Emergency Management Coordinator	Fire/EMC
Bob Krugmire*	Engineer	Public Works & Utilities (PWU)-Water Resources
Rob Walls	Foreperson	Parks, Recreation & Libraries (open space)
Amanda Martinez*	GIS Specialist	Community Development
Bruce Rindahl*	Flood Warning Manager	Mile High Flood District
Irene Merrifield	Mitigation Planning Supervisor	DHSEM
Mikeal Parlow*	Policy & Budget Coordinator	General Services
Shelby Wood*	Senior Management Analyst	Economic Development
Andrew Hawthorn*	Stormwater Utility Administrator	Community Development
Heather Otterstetter*	Stormwater Coordinator and Floodplain Administrator	Community Development
Kurt Muehlemeyer*	Street Operations Manager	PWU-Streets
Bridger Tomlin*	Sustainability Associate	City Manager's Office
Andrea Song*	Utilities Operations Manager	PWU-Water Utilities
Josh Nims*	Water Quality Resource Manager	Community Development
Brian McCoy*	City Forester	Parks, Recreation & Libraries (Open Space)

*indicates attendance during mitigation planning meetings

The City of Westminster's HMPC members have varying degrees of experience related to natural hazard mitigation projects and planning. Departments that address housing and human services include Community Development and Economic Development. In addition, the Emergency Management Coordinator is an active member of the City's Homeless Task Force which is chaired by our Parks, Recreation and Libraries department (also a participant in the planning process) and includes two homeless navigators and representatives from Community Development and Police. PRL, Police, and Open Space staff routinely interact with those experiencing homelessness and assist them connecting with non-profit organizations and county human services. The table below outlines staff expertise and overall capability and expertise within the six mitigation categories outlined in Activity 510 in the National Flood Insurance Program's Community Rating System (CRS).

Table 3-4 City of Westminster Staff Expertise with Mitigation Categories

Community Department/Office	Prevention	Property Protection	Natural Resource Protection	Emergency Services	Structural Flood Control Projects	Public Information
Police Department				✓		✓
Fire Department	✓	✓	✓	✓		✓
Fire department – Emergency Management	✓	✓		✓		✓
City Manager's Office			✓			✓
Community Development – Planning Division	✓	✓	✓		✓	✓

Community Department/Office	Prevention	Property Protection	Natural Resource Protection	Emergency Services	Structural Flood Control Projects	Public Information
Community Development – Engineering Division	✓	✓	✓		✓	
Geographic Information Systems	✓		✓			✓
Parks, Recreation, and Libraries	✓		✓		✓	✓
Public Works and Utilities – Street Operations Division	✓	✓			✓	
Public Works and Utilities – Utilities Operations Division	✓	✓			✓	
Public Works and Utilities – Water Resources & Quality Division	✓	✓	✓		✓	
Public Works and Utilities – Utilities Engineering Division	✓	✓			✓	
Finance Department	✓				✓	
Human Resources – Risk Management	✓					✓
Information Technology	✓					
Economic Development	✓	✓				

During the planning process, the HMPC communicated through a combination of virtual and face-to-face meetings, email, and social media (Facebook). The HMPC formally met four times during the planning period (October 2022 – May 2023). The purpose of these meetings and workshops is described in **Table 3.5**. Agendas for each meeting and lists of attendees are included in **Appendix B**

Table 3-5 Schedule of Meetings

Meeting Date	Meeting Topic	Audience	Associated CRS Planning Steps*
October 11 th , 2022	HMP Kickoff Meeting (virtual)	City of Westminster Stakeholders	1,2,3,4,5
February 22 nd , 2023	Hazard Risk Assessment and Hazard Identification Meeting (virtual)	City Department Directors and Managers	4,5,6,7,8
March 16 th , 2023	Flood Emergency Operations Plan task Kickoff Meeting (virtual)	City of Westminster Emergency Manager, City Dept. and Managers	1,3,4,5
May 10 th , 2023	Mitigation Strategy Meeting (in person)	City Department Directors and Managers	1,3,4,5

* All 10 CRS Planning Steps were covered during the planning process. The text in this chapter provides more information on the fulfillment of the requirements for each step.
 * Steps 9 and 10 will take place once the plan is adopted.

The planning process officially began on October 11, 2022, with a virtual kickoff meeting. The meeting covered the scope and purpose of the plan update, participation requirements of HMPC members, and the proposed project work plan and schedule. WSP reviewed the list of identified hazards with HMPC

members. Participants were encouraged to voice ideas for the project and to suggest other stakeholders that would be beneficial to the planning process. The sign-in sheets and agendas from each of these meetings can be found in **Appendix B**.

Planning Step 2: Involve the Public

The community outreach and engagement efforts for the planning process were led by the city's Emergency Management Coordinator. Outreach has been a vital part of the update process beginning before the HMPC kickoff meeting with two in-person community outreach events. The city recognizes that the public plays an important role in hazard resilience, both as a source of information on hazards and problem areas, but also to increase understanding of how residents can protect themselves and their property from hazard impacts. The city also recognizes that certain populations are more vulnerable to hazards, such as the unhoused, and that languages other than English (notably Spanish and Hmong) are commonly used by residents. With this in mind an effort was made to share the messaging on this HMP update as broadly and as equitably as possible through a variety of print and digital media and online and in-person events. Westminster Emergency Management targeted multiple community organizations, including those that work with underserved communities and vulnerable populations, as part of the public outreach efforts related to this planning process. Social media was a vital resource in garnering public input and awareness. Groups that have Facebook accounts include Community Reach (mental health), Growing Home (housing assistance), Hope House, Almost Home, Beyond Home, religious organizations, Precious Child (donations), school districts, COVOAD, Westminster Cares (faith-based food and housing assistance). Using the Westminster Emergency Management Facebook page, the Emergency Management Coordinator was able to engage thousands of citizens and invite them to participate in the risk assessment and plan update process. Outreach was also accomplished through articles in the city's quarterly news publication (print media), *The City Edition*, the city's online weekly News, and the City of Westminster's Facebook page asking for public participation and input in the planning process.

The extensive outreach efforts by the city are not limited to this planning process and are ongoing. There are two mitigation actions in this plan's Mitigation Strategy related to outreach both online and in-person (MH1 and MH2 in Section 5.4.4) that relate to this topic. These actions have been updated with more specifics to target potentially vulnerable or underserved populations, including providing more information translated into Spanish and Hmong and use of American Sign Language services in the future.

Community Outreach Events

A community outreach Firewise Presentation was held on September 17th, 2022. To help improve awareness of fuel sources on properties, plan for sheltering and evacuating, create preparedness kits and learn about the Lookout Alert emergency notification system. A request for public input for the 2022-2023 City of Westminster Hazard Mitigation Plan was distributed on January 11th, 2023 and was open until January 31, 2023. The survey contained 7 questions to help solicit public input on hazards of concern and suggestions for reducing the impacts of hazards before they occur.

The City of Westminster also held two "Westy Prepared Series" events. One was a Flood Awareness Event that was held on February 11, 2023 and the other a Drought Awareness event that was held April 8th, 2023. Each of these events helped to spread knowledge of both flood and drought risks in the city and the Denver Metro area overall. Westy Prepared community hazard and preparedness discussions were held at Irving Street Library. Flyers regarding these events were posted and available at Irving Street Library which is frequented by unhoused persons and is located in our most socially vulnerable area of the City. Irving Street Park (adjacent to the Irving Street Library) is the primary congregation area for our homeless during the day.

Also, on April 20th, 2023, a CFIRE Presentation on Flood Preparedness was held. This presentation allowed City of Westminster residents and other participants were given the opportunity to provide input on flood risks and how to become better prepared and more informed.

Documentation of these meetings can be found in **Appendix B**.

Public Outreach Through City Website and Social Media

Westminster Emergency Management maintains an active Facebook page that as of April 2023, has 3,000+ followers (see <https://www.facebook.com/City-of-Westminster-Emergency-Management-409969596020244/>). The use of social media helped the HMPC improve the public’s awareness and engagement with the HMP Update. Between April 2022 and August 2023, the EMC posted 15 community risk assessment/HMP specific posts that reached over 51,000 local residents and resulted in over 9,000 social media engagements. Specifically to the public review draft, the EMC advertised the plan draft on Facebook until August 15th, 2023, where it received over 2,000 views, 124 likes, and 222 post engagements. The online public comment form did not receive any submissions of comments from the public.

Figure 3-1 Excerpts from Emergency Management Facebook Page

The figure consists of three distinct promotional materials:

- Firewise Presentation Poster:** Features a red fire extinguisher on the left. The text reads: "FIREWISE PRESENTATION", "Improve awareness of fuel sources on properties, plan for sheltering and evacuating, create preparedness kits and learn about the Lookout Alert emergency notification system.", "SATURDAY, SEPTEMBER 17 10-11:30 A.M. COLLEGE HILL LIBRARY 3705 W 112TH AVE. AGE 18+", "REGISTER ONLINE WWW.WESTMINSTERLIBRARY.ORG", and logos for the City of Westminster and Westminster Public Library.
- Facebook Post:** A screenshot of a post from "City of Westminster Emergency Management" shared from NOAA Climate.Gov's post. The text states: "Colorado has warmed by 2 degrees in the past 30 years and 2.5 degrees in the past 50 years. (Source: http://www.colorado.edu/...Climate_Change_CO_Report_2014_FIN...) Spring is coming 2-4 weeks earlier than it used to which increases our water usage. Our changing climate is one of the topics we will be considering in our updated natural hazard mitigation plan. If you would like to be part of our community risk assessment process, please contact our emergency management coordinator at (303) 658-4550 or gmoser@cityofwestminster.us. Be aware, be prepared, be safe." It includes a "Global Warming FAQ" graphic and engagement statistics: 3,235 People Reached, 183 Reactions, Comments & Shares, and 171 Post Clicks.
- Westy Prepared Series Poster:** A green-themed poster with a house icon. Text includes: "WESTY PREPARED SERIES", "Preparedness is a shared responsibility of the City and its residents! This program introduces participants to all-community hazards, as well as mitigation and preparedness efforts.", "FLOOD AWARENESS: SATURDAY, FEB. 11 11:00-12:30 PM, Irving Street Library Community Room", "DROUGHT AWARENESS: SATURDAY, APRIL 8 11:00-12:30 PM, Irving Street Library Community Room", "Can't attend in-person? Register online to receive a Zoom invitation!", and a QR code. Logos for the City of Westminster and Westminster Public Library are at the bottom.

Planning Step 3: Coordinate with Other Departments and Agencies

There are numerous organizations whose goals and interests' interface with hazard mitigation in The City of Westminster. Coordination with these organizations and other community planning efforts is vital to the success of this plan's update and implementation. The HMPC determined that data collection, mitigation strategy development, and plan approval would be greatly enhanced by inviting state and federal agencies and power and communications organizations to participate in the process. Coordination with specific state agencies is an additional requirement for local hazard mitigation plans per the FEMA Plan Review Tool modified by Colorado DHSEM in 2023. The following is the list of agencies and how they were coordinated with during the 2023 update process.

Table 3-6 Summary of State and Other Agency Coordination

Agency	Coordination Notes
Colorado Climate Center	Confirmed 2014 Climate Change in Colorado report was still the latest resource specific to Colorado
Colorado Geological Survey	Coordinated with on information on geologic hazards and utilized GIS data to inform earthquake and swelling soils hazards.
Colorado Water Conservation Board	Reviewed information on past droughts and their impacts on the planning area. Incorporated information from Drought Mitigation Plan into the risk assessment. Requested and reviewed information on flood insurance policies and claims including repetitive loss data; Colorado Rules and Regulations for Regulatory Floodplains (2 CCR 408-1)
Colorado Department of Transportation	Invited to participate in the HMPC meetings.
Colorado State Forest Service	Invited to participate in the HMPC meetings. Provided data used for wildfire history, and risk and vulnerability assessments.
Colorado Department of Natural Resources, Division of Water Resources - Office of Dam Safety	Provided database of dams with non-failure flood risk used to inform HIRA.
Colorado Resiliency Office	Outreach on related initiatives; CRO provided information on COVID-19 Regional Resiliency and Recovery roadmaps, with a focus on economic resiliency.
Other: Neighboring jurisdictions	Emergency managers with Adams and Jefferson Counties invited to HMPC meetings. Those counties and the emergency managers from the municipalities of Thornton, Northglenn and Arvada reminded of the process during routine check-in meetings with Westminster Emergency Management. Mile High Flood District invited to and participated in HMPC meetings.
Other: High and Significant hazard dams Dam Owners	Westminster owns Ketner and McKay dams. PWU-Utilities engineer was on the HMPC is on the Farmers Reservoir and Irrigation Company (FRICO) board which owns Standley lake and ditch infrastructure.
Other: Formal and Informal Community Organizations	Westminster Emergency Management targeted multiple community organizations, including those that work with underserved communities and vulnerable populations, as part of the public outreach efforts related to this planning process (see Planning Step 2 Involve the Public). The primary tool used was social media which has proven to be an effective tool for City outreach. Westminster Emergency Management shared information on Facebook to invite input through the public workshops and survey related to the plan update. The Westy Prepared Facebook profile has over 5,000 followers. Groups that have

Agency	Coordination Notes
	Facebook accounts include Community Reach (mental health), Growing Home (housing assistance), Hope House, Almost Home, Beyond Home, religious organizations, Precious Child (donations), school districts, COVOAD, Westminster Cares (faith-based food and housing assistance). As documented in Planning Step 2 Involve the Public between April 2022 and August 2023, the EMC posted 15 community risk assessment/HMP specific posts that reached over 51,000 local residents and resulted in over 9,000 social media engagements. Specifically to the public review draft, the EMC advertised the plan draft on Facebook until August 15th, 2023, where it received over 2,000 views, 124 likes, and 222 post engagements

Other Community Planning Efforts and Hazard Mitigation Activities

Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability from natural hazards. As such, this plan was coordinated with, and builds from, other related planning efforts that help reduce hazard losses. The City of Westminster uses a variety of comprehensive planning mechanisms, such as a master plan, an emergency response plan and city policies, to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this multi-hazard mitigation plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from the following existing plans, studies, reports and initiatives as well as other relevant data from Adams and Jefferson Counties and the State of Colorado. These and other related plans are discussed further in **Section 2.6 Assessing Capabilities**.

These plans include:

- 2007 Storm Drainage Study (City of Westminster)
- 2018 State of Colorado Natural Hazard Mitigation Plan
- City of Westminster Comprehensive Plan
- City of Westminster Drought Plan
- City of Westminster Emergency Plan and Management System
- City of Westminster Strategic Plan
- City of Westminster Sustainability Plan (2019)
- Colorado Communities for Climate Change Study
- FEMA Flood Insurance Study
- Open Space Master Plan (City of Westminster)
- Police Service Program
- Source Water Protection Plan
- State of Colorado Emergency Operations Plan
- Various Flood Studies
- Watershed Fire Study
- Surrounding counties and communities' mitigation plans
 - Adams County Hazard Mitigation Plan
 - City and County of Broomfield Hazard Mitigation Plan
 - Jefferson County Multi-Hazard Mitigation Plan
 - Thornton//Federal Heights//Northglenn Hazard Mitigation Plan

Other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment and capability assessment.

3.4.2 Phase 2: Assess Risks

Planning Steps 4 and 5: Identify the Hazards and Assess the Risks

The Emergency Management Coordinator researched and identified all the natural hazards that have or could impact the city. Where data permitted, geographic information systems (GIS) were used to display, analyze and quantify hazards and vulnerabilities. The HMPC also updated a mitigation capability assessment to review and document the city's current capabilities to mitigate risk and reduce vulnerability from natural hazards. By collecting information about existing government programs, policies, regulations, ordinances and emergency plans, the HMPC can assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities previously identified. A more detailed description of the risk assessment process and the results are included in Chapter 4: Risk Assessment; the Capability Assessment is described in Section 2.6.

3.4.3 Phase 3: Develop The Mitigation Plan

Planning Steps 6 and 7: Set Goals and Review Possible Activities

WSP facilitated brainstorming and discussion sessions with the HMPC that described the purpose and the process of developing planning goals and objectives, a comprehensive range of mitigation alternatives and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in **Chapter 5: Mitigation Strategy**. Additional documentation on the process the HMPC used to develop the goals and strategy is in **Appendix B**.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, WSP produced a complete draft of the updated plan. Other agencies were invited to comment on this draft as well. HMPC and agency comments were integrated into the second updated draft, which was advertised and posted for review and comment on the city's website; no additional public comments were received. WSP addressed comments from the Colorado Division of Homeland Security and Emergency Management and submitted a final for FEMA Region VIII to review and approve, contingent on final adoption by the City Council.

3.4.4 Phase 4: Implement The Plan and Monitor Progress

Planning Step 9 Adopt the Plan

To secure buy-in and officially implement the plan, the plan was adopted by the City of Westminster City Council on the dates included in the adoption resolution in **Appendix C: Adoption Resolution**. Once the adoption is complete, final approval by FEMA occurs.

Planning Step 10: Implement, Evaluate, and Revise the Plan

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time. Since its initial development the City of Westminster has been proactive in implementing the mitigation actions identified in the plan. A discussion on the progress with implementation is included in Chapter 5. Each recommended mitigation action includes key descriptors, such as a lead manager and possible funding sources, to help initiate implementation. An overall implementation strategy is described in Chapter 7: Plan Implementation and Maintenance.

Finally, there are numerous organizations within the city whose goals and interests interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning Step 3, is paramount to the ongoing success of this plan and mitigation in the City of Westminster and is addressed further in Chapter 7. An updated overall implementation strategy and maintenance and a strategy for continued public involvement are also included in Chapter 7.

4 RISK ASSESSMENT

Requirement §201.6(c)(2):

[The risk assessment shall provide the] factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

A simple way to define risk is the relationship between hazards and vulnerabilities. Reducing community risk through preparedness, mitigation, prevention, protection, response, continuity and recovery is the primary purpose of emergency management. To address community risk, we must first develop a robust, evidence-based assessment of our hazards and vulnerabilities and recognize that both change over time.

Hazards encompass both natural and human-caused phenomenon that have the potential to cause harm. Natural hazards are primarily meteorological, geological, environmental, or epidemiological. Natural hazards generally provide extensive historical records to support our analysis and understanding. However, as recent trends in global weather are demonstrating, natural hazards are not a steady state and the historical record supports the observation that the environment goes through cycles which may be influenced by human activity.

Historically, pandemics have been the greatest threat to our communities and as a result, public health programs were among our first efforts to mitigate natural hazards. Human-caused hazards (technical/industrial) are a result of our technological development. Some aspects of technical/industrial hazards, such as chemicals, have a well-established history as a hazard. Other technologies, such as cyber infrastructures, are more recent developments and our understanding of the inherent hazards associated with this technology is continuing to develop. Technical/industrial hazards change much more quickly than natural hazards. They are also generally limited in their geographic extent, but some hazards such as radiological contamination resulting from the Chernobyl and Fukushima nuclear accidents have had global impacts.

Threats are a sub-category of human-caused hazards. Threats are intentional and include crime, terrorism and war. Civil defense, the predecessor of today's comprehensive emergency management, was created to help protect our communities from the dangers of war. Each of these hazards present unique potential to cause harm to our human, material, economic and environmental assets. Hazards may also occur concurrently or sequentially with or without a direct relationship.

4.1 Community Description

4.1.1 Population and Demographics

The city has approximately 116,317 residents and the average age is 36.4 years old. Westminster is the 8th most populous city in Colorado and 257th most populous city in the United States. Its population density is 3,363 per square mile.

7.6% of the population is foreign born and 11.3% speaks a language other than English in the home. In 2021, 5% of the population was under 5 and 15.3% was over 65 years of age. 41.1% of the persons over 25 years old have a bachelor's degree or higher.

There are approximately 51,037 households with an average size of 2.4 persons. The median household income in 2021 was \$86,688 and the per capita income was \$45,864. 6.6% of the population live below the American Community Survey poverty line.

- 70.3% White
- 24.2% are ethnically Hispanic (primarily in southern Westminster)

- 6.9% Asian, Black, Native American and other
- Approximately 10-15% of the population has access or functional needs.

Education Attainment:

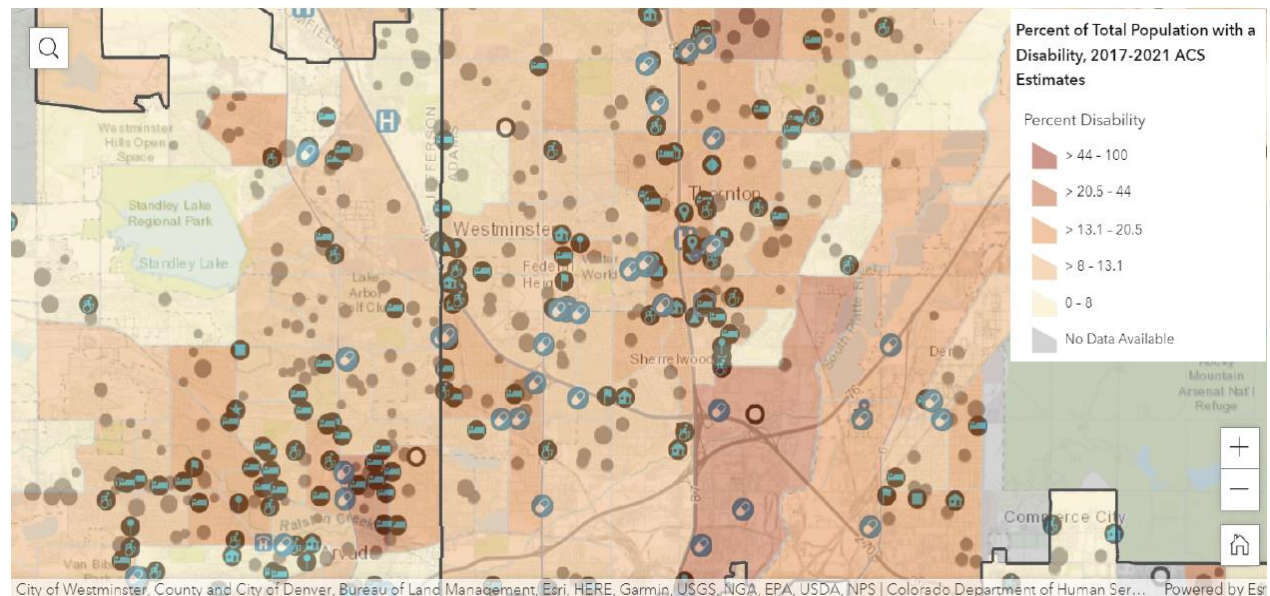
- 28.5% hold bachelor’s degrees
- 12.6% hold master’s, professional, or doctoral degrees
- Households: 47,797 (63.7% owner occupied, 36.3% rental)

4.1.2 High Vulnerability Populations

Access and Functional Needs

The Centers for Disease Control (CDC) Social Vulnerabilities Index 2020 data indicates that approximately 14,536,174 Westminister residents have some form of disability (i.e., mobility, cognitive, sensory, independent living and self-care). CDPHE’s web site on Community Inclusion in Colorado maintains detailed AFN demographic and community resource information. (C. D. Environment 2016)

Figure 4-1 Percent of Population with Total Disability



Source: CDPHE

Homeless and Economically Vulnerable

Poverty, food security, affordable housing and homelessness continue to be a challenge to our overall quality of life, resilience and sense of community. The cost of living in Colorado rose by 32% between 2001 and 2015. Our poverty level has risen to 6.6% in recent years, and homelessness and food insecurity are also growing.

- 53% of our homeless population are employed.
- 917 – the approximate number of people living on the streets, in camps or in cars on any given day.
- An estimated 912 Westminister K-12 students meet the Department of Education’s definition of homeless.
- 2,500 – the approximate number dependent on temporary housing with family and friends on a given day (based on Department of Education standards).
- 7,500 – estimated number of homeless associated with, but not captured in DOE methodology.
- 7,553 (6.6%) of our population living at or below the poverty rate.

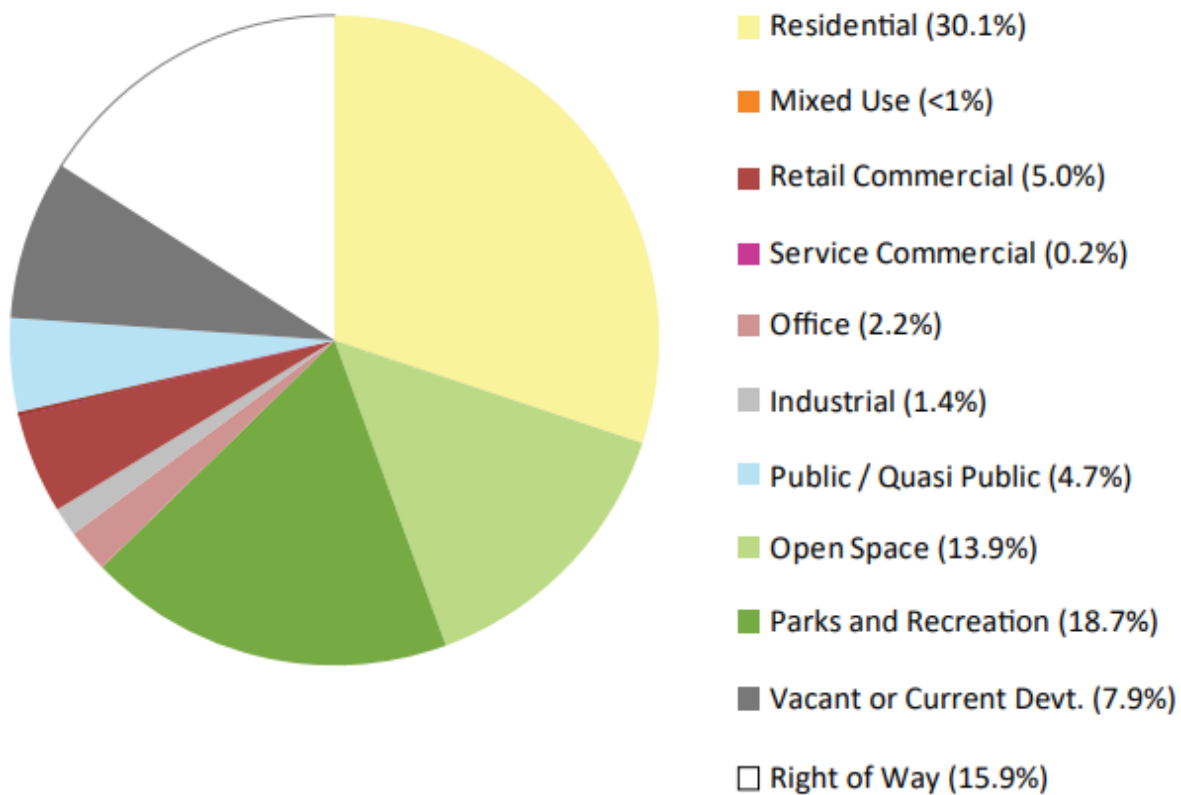
- In 2021, 24.6% of children were in households with supplemental security income, cash public assistance income or Food Stamps/SNAP benefits.
- Westminster has approximately 191 mobile home units.

Our emergency/disaster planning efforts must ensure our AFN, homeless, and economically vulnerable populations are provided equal access and provided reasonable accommodation.

4.1.3 Open Space

In 1985, the city established the goal to maintain 15% of the area as open space. As a result, we have 3067.2 acres of managed open space that preserves our environment and enhances life for our residents:

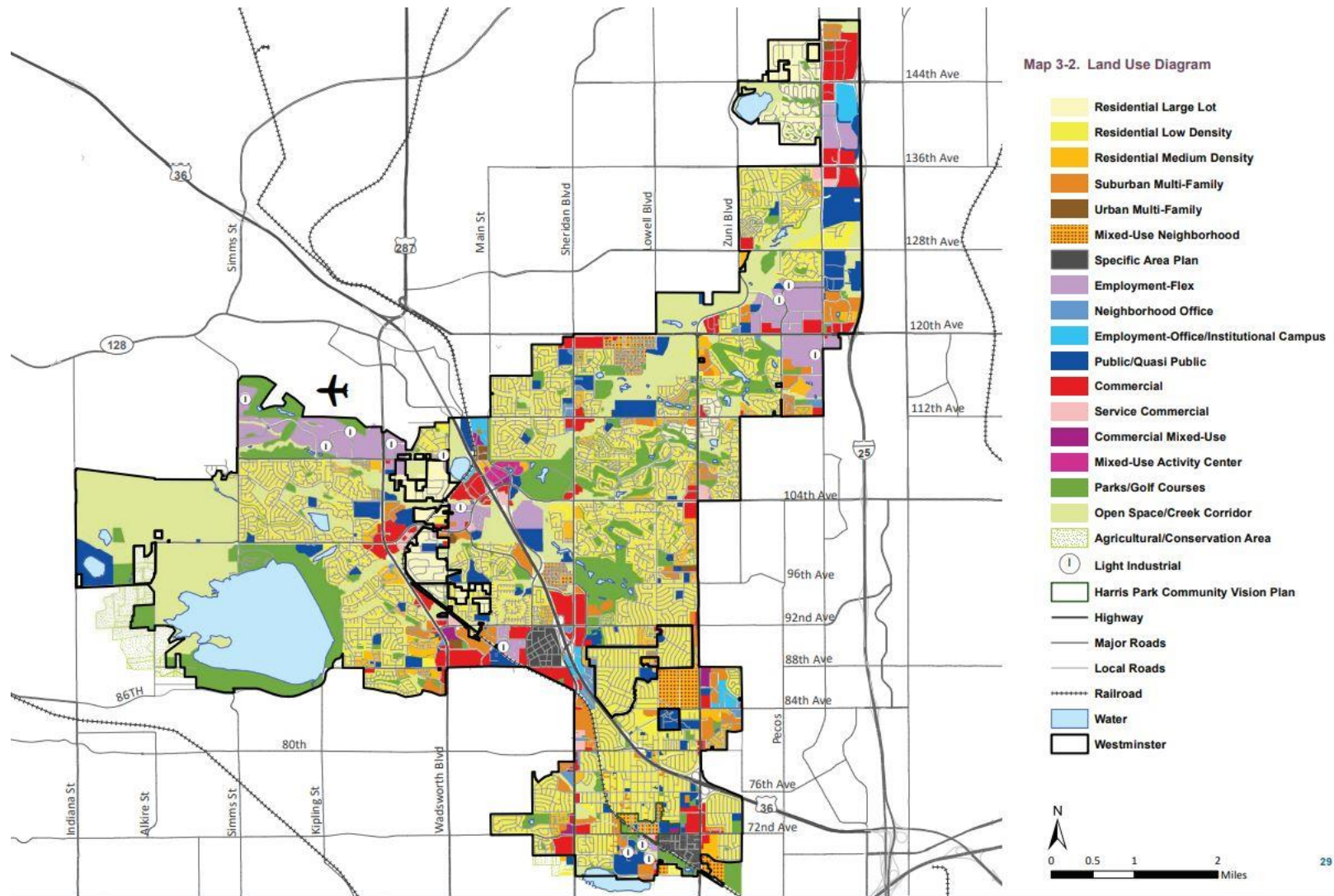
Figure 4-2 2013 Existing Distribution of Land Area in the City



Source: City of Westminster 2013 Comprehensive Plan

-

Figure 4-3 City of Westminster Land Use Diagram



Source: City of Westminster Comprehensive Plan 2040

4.1.4 Historic Sites

There are 18 identified historic sites in the city. There are also five historic properties without local designation. Each historic landmark address and the date that it was approved by City Council is shown in Table 4.1 below.

Table 4-1 Westminster Historic Landmarks and Sites

Landmark Number	Landmark Name	Address	Council Approval
1	Westminster Grange Hall	3935 W. 73rd Ave.	3/24/2003
2	Charles and Julia Semper Farm	9215 Pierce St.	1/12/2005
3	Savery Mushroom Farm Water Tower	110th Ct. and Federal Blvd.	1/24/2005
4	Henry House Residence	7319 Orchard Ct.	5/9/2005
5	Wesley Chapel Cemetery	120th Ave and Huron St.	11/28/2005
6	Merton and Mary Williams House	7335 Wilson Ct.	5/8/2006
7	Lower Church Lake Barn and Silo	10850 Wadsworth Blvd.	8/28/2006
8	Rodeo Super Market	3915 W. 73rd Ave.	9/25/2006
9	Perry House Residence	4199 W. 76th Ave.	11/14/2007
10	Margaret O'Gorman Boarding House and Residence	8198 Irving St.	2/13/2008
11	Dudley C. Shoenberg Memorial Farm	5202 W. 73rd Ave.	3/31/2008
12	Westminster's First Town Hall	3924 W. 72nd Ave.	4/28/2008
13	Penguin Building	7265-7269 Lowell Blvd.	8/25/2008
14	Red & White Grocery Store	3947-3949 W. 73rd Ave.	11/24/2008
15	Church's Stage Stop Well	10395 Wadsworth Blvd.	4/12/2010
16	Bowles House	3924 W. 72nd Ave.	4/9/2012
17	Marion-Wilkins-Ward Barn and Windmill	SWC 120th and Pecos St.	1/14/2013

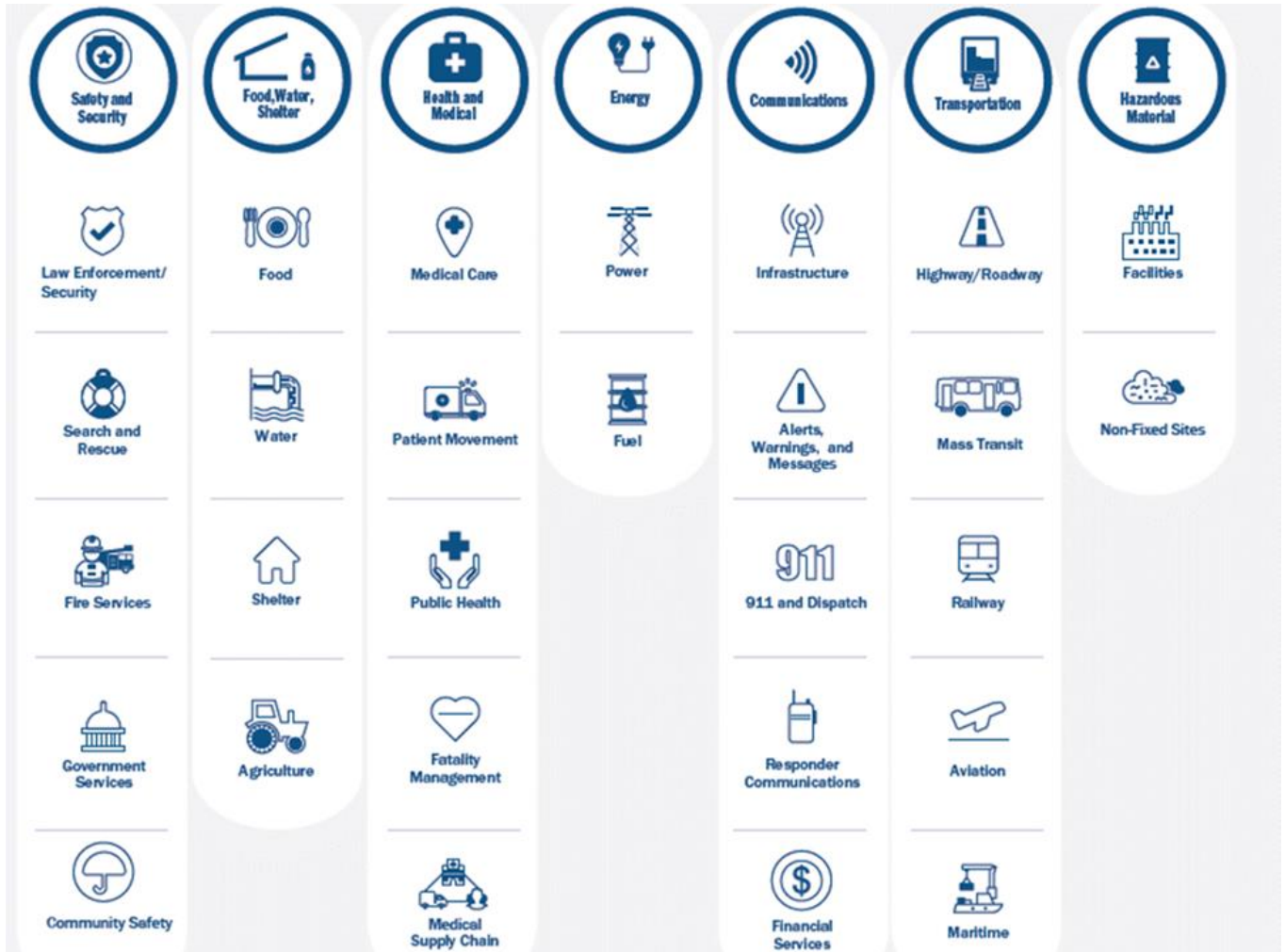
Landmark Number	Landmark Name	Address	Council Approval
18	Westminster Presbyterian Church	3990 W. 74th Ave.	1/13/2020
Historic Properties Without Local Designation			
	Landmark Name	Address	
	Gregory House	8140 Lowell Blvd.	
	Harris Park School	7200 Lowell Blvd.	
	Metzger Farm Open Space	12080 Lowell Blvd.	
	Union High School	3455 W. 72nd Ave.	
	Westminster University/Pillar of Fire (Not in City)	3450 W. 83rd Ave.	

Source: [Historic Preservation & Westminster History \(cityofwestminster.us\)](https://www.cityofwestminster.us/historic-preservation-and-westminster-history)

4.1.5 City Critical Infrastructure

A critical facility is defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. Much of this data is based on GIS databases associated with the 2022 Homeland Infrastructure Foundation-Level Data (HIFLD). Other critical facility databases were also used, such as the National Bridge Inventory (NBI), with supplementation from the City of Westminster's GIS data where applicable.

Figure 4-4 FEMA Lifeline Categories



Westminster has a relatively young infrastructure with much of it having been built in the last 30 years. As a result, much of its infrastructure is comparatively young and has benefited from modern codes and standards. The largest number of critical facilities in the City of Westminster are transportation non-scour bridges in good and fair condition with 60 total. This is followed by communication Microwave Service Towers with 49 total. Third are public schools which are considered to be safety and security facilities. Overall, there are 240 critical facilities located within the City of Westminster. The critical facilities within the City of Westminster are shown in Table 4.2 below.

Table 4-2 City of Westminster Critical Facilities

Category	Type	Count
Communications	Microwave Service Tower	49
Energy	Substation	2
Food, Water, Shelter	Shelter	3
Food, Water, Shelter	Wastewater Plant	1
Food, Water, Shelter	Water Storage	2
Food, Water, Shelter	Water Treatment Facility	3
Hazardous Material	Tier II	25

Category	Type	Count
Health and Medical	Ambulatory Surgical Center	3
Health and Medical	Assisted Living Residence	7
Health and Medical	Clinic	2
Health and Medical	Community Clinic	1
Health and Medical	End Stage Renal Disease Facilities	4
Health and Medical	ER	2
Health and Medical	Federal Qualified Health Center	1
Health and Medical	Heliport	1
Health and Medical	Hospice	3
Health and Medical	Hospital	2
Health and Medical	Nursing Home	3
Health and Medical	Psychiatric Residential Treatment Facilities	1
Health and Medical	Urgent Care	3
Safety and Security	College/University	3
Safety and Security	Fire Station	6
Safety and Security	Historic Building	1
Safety and Security	Justice Services	1
Safety and Security	Library Services	2
Safety and Security	Maintenance	2
Safety and Security	Maintenance Operations	1
Safety and Security	Municipal Government Offices	1
Safety and Security	Office	3
Safety and Security	Police & Fire Administration	1
Safety and Security	Private School	6
Safety and Security	Public School	29
Safety and Security	Storage	1
Safety and Security	Supplemental College	2
Transportation	Non-Scour Fair Condition Bridge	28
Transportation	Non-Scour Good Condition Bridge	32
Transportation	Rail Station	1
Transportation	Scour Fair Condition Bridge	1
Transportation	Scour Good Condition Bridge	1
Total		240

Source: City of Westminster, CDPHE, CEPC, HIFLD, NBI, WSP GIS Analysis

4.2 Identifying Hazards

4.2.1 Natural Hazard's Introduction

The City of Westminster has a limited history of natural disasters. The primary concerns are extreme winter and summer storm events which impact transportation, business operations and can endanger life and property. The city is located at the headwaters of the Big Dry Creek and Little Dry Creek. Big Dry Creek is a tributary to the South Platte River and Little Dry Creek is a tributary to Clear Creek before becoming a tributary stream to the South Platte River. This limits our riverine and street flooding hazard to

events related to extreme precipitation over the immediate catchment area of Big Dry Creek and Little Dry Creek.

Eastern Colorado is largely aseismic, but an event similar in scale to the region’s 1882 earthquake would be expected to result in damages to building facades, roads and pipelines. Swelling soils are a pervasive hazard that causes significant damage to foundations, roads and sidewalks.

Water security will depend on our appreciation of the limitations of our semi-arid environment and our willingness to be proactive, responsible and strategic in managing water resources, demand and use. Drought and watershed degradation due to wildfire, invasive/noxious species and pollution is a perennial hazard for the entire Front Range. A multi-decade drought such as the ones recorded in the paleo record would dramatically impact our environment and economy.

While the long-term effects of climate change continue to be a topic of research and analysis, current evidence supports the conclusion that the environment is warming and we can expect greater swings in weather extremes; dryer and wetter periods, warmer and colder events. This trend raises the possibility of unprecedented extreme weather events such as the 2013 floods in nearby jurisdictions and an increased frequency of “bomb cyclones” resulting in sudden and extreme winter events as occurred in 2019 and 2022.

Our natural hazards present a persistent and potentially increasing threat to our human, built and natural environment and our economic activities. Natural hazards are well understood, but the potential for more frequent and extreme events can only be anticipated. Just as the environment is a complex interconnected and interdependent system, natural hazards may also be connected resulting in cascading scenarios that can amplify the consequences far beyond a single incident. This assessment seeks to evaluate each hazard in support of developing hazard specific priorities and strategies. However, we must also be mindful of the interdependences and complexities that may challenge standalone mitigation efforts while we also seek to identify strategies that may provide multi hazard mitigation.

The Department of Homeland Security’s “Threat and Hazard Identification and Risk Assessment Guide-Comprehensive Preparedness Guide (CPG 201),” characterizes threats and hazards as natural, technological, and human caused. The following table provides examples of each of these categories:

Table 4-3 Categories of Threats and Hazards

Natural	Technological	Human-caused
<ul style="list-style-type: none"> ▪ Avalanche ▪ Animal disease outbreak ▪ Drought ▪ Earthquake ▪ Epidemic ▪ Flood ▪ Hurricane ▪ Landslide ▪ Pandemic ▪ Tornado ▪ Tsunami ▪ Volcanic eruption ▪ Wildfire ▪ Winter storm 	<ul style="list-style-type: none"> ▪ Airplane crash ▪ Dam failure ▪ Levee failure ▪ Mine accident ▪ Hazardous materials release ▪ Power failure ▪ Radiological release ▪ Train derailment ▪ Urban conflagration 	<ul style="list-style-type: none"> ▪ Biological attack ▪ Chemical attack ▪ Cyber incident ▪ Explosives attack ▪ Radiological attack ▪ Sabotage ▪ School and workplace violence

Source: FEMA

For the purposes of this risk assessment, our Emergency Management Coordinator (EMC) reviewed the hazards and threats in CPG-201 and dropped those hazards which do not occur in Westminster (e.g., avalanche, hurricane, landslide, tsunami, volcanic eruption etc.) from consideration in our local risk assessment process. The EMC also reviewed the list of hazards and threats identified on the Ready.gov site and in the State of Colorado 2018-2023 Natural Hazards Mitigation Plan to identify other natural hazards. All city departments and our Natural Hazards Mitigation Plan-Update committee and community stakeholders were invited to review and comment on this list of identified hazards and threats. As a result, we have identified, and in some cases adapted, federal and state identified hazards to reflect our local environment and concerns. For example, the city has very little wildland urban interface, but we are concerned about fire in our open spaces and the potentially catastrophic hazard of wind-driven events such as the 2021 Marshall Fire.

This risk assessment includes all of the same natural hazards identified in our 2018 Natural Hazards Mitigation Plan and modifies the earlier list from the previous LHMP as indicated in the following table:

Table 4-4 Natural Hazards Identification

2023 Hazards	Comments on Modifications from 2018 HMP
Climate Change	Updated with best available information and in compliance with State and FEMA HMP guidance
Drought & Water Security	No change
Dam Failure	No change
Earthquake	No change
Epidemic/Pandemic	No change
Erosion, Deposition and Turbidity	No change
Swelling Soils	No change
Extreme Cold	No change
Extreme Heat	No change
Flooding	No change
Invasive and Noxious Species	No change
Severe Summer Storms	Combines former hail and lightning into this profile,
Severe Winter Storms	No change
Solar/Geomagnetic Storm	No change
Tornado	No change
Open Space Fire (Wildfire)	Includes considerations of wind-driven fire as a more pressing concern due to Marshall Fire
Windstorm	No change

Overall, natural hazards have not changed significantly since the 2018 assessment, with the exception being Hail and Lightning combined with Severe Summer Storms and incorporating wind-driven fires into the Open Space Fire profile.

The following hazards in the 2018 Colorado State Hazard Mitigation Plan are not addressed due to the focus of the Westminster LHMP on natural hazards:

- Wildlife-Vehicle Collisions
- Infrastructure Failure
- Hazardous Materials Release
- Mine Accidents
- Power Failure
- Radiological Release
- Chemical, Biological, Radiological, and Nuclear Attack
- Cyber Attack
- Explosive Attack

These natural hazards in the 2018 Colorado State Hazard Mitigation Plan either do not occur or have minimal impacts in the planning area and are not addressed:

- Dense Fog
- Avalanche
- Landslides, Mud/Debris Flows, and Rockfalls
- Radon, Carbon Monoxide, Methane Seeps
- Subsidence & Abandoned Mine Lands
- Animal Disease
- Wildlife

Since 1965 Adams and Jefferson counties where the City of Westminster is located has received 25 presidential disasters. Four have been biological resulting from the COVID-19 pandemic. Two were considered coastal storm disaster declarations following Hurricane Katrina and Rita in 2005. Five have been federally declared fire disasters with the most recent one occurring in 2012. Nine have been flooding declarations, with the most recent occurring in 2015. Four have been snowstorms and one has been a tornado. These are shown in Table 4-5 below.

Table 4-5 Westminster Presidential Disaster Declaration History, 1965 – 2023

Declaration Number	Year Declared	Incident Type	Declaration Title	County
DR-4498-CO	2020	Biological	COVID-19 PANDEMIC	Adams
DR-4498-CO	2020	Biological	COVID-19 PANDEMIC	Jefferson
EM-3436-CO	2020	Biological	COVID-19	Jefferson
EM-3436-CO	2020	Biological	COVID-19	Adams
DR-4229-CO	2015	Flood	SEVERE STORMS, TORNADOES, FLOODING, LANDSLIDES, AND MUDSLIDES	Adams
DR-4145-CO	2013	Flood	SEVERE STORMS, FLOODING, LANDSLIDES, AND MUDSLIDES	Adams
DR-4145-CO	2013	Flood	SEVERE STORMS, FLOODING, LANDSLIDES, AND MUDSLIDES	Jefferson
EM-3365-CO	2013	Flood	SEVERE STORMS, FLOODING, LANDSLIDES, AND MUDSLIDES	Adams
EM-3365-CO	2013	Flood	SEVERE STORMS, FLOODING, LANDSLIDES, AND MUDSLIDES	Jefferson
FM-2975-CO	2012	Fire	LOWER NORTH FORK FIRE	Jefferson
FM-2873-CO	2011	Fire	INDIAN GULCH FIRE	Jefferson
EM-3270-CO	2007	Snowstorm	SNOW	Jefferson
EM-3270-CO	2007	Snowstorm	SNOW	Adams
EM-3224-CO	2005	Coastal Storm	HURRICANE KATRINA EVACUATION	Adams
EM-3224-CO	2005	Coastal Storm	HURRICANE KATRINA EVACUATION	Jefferson
EM-3185-CO	2003	Snowstorm	SNOW	Adams
EM-3185-CO	2003	Snowstorm	SNOW	Jefferson
DR-1421-CO	2002	Fire	WILDFIRES	Adams
DR-1421-CO	2002	Fire	WILDFIRES	Jefferson
FM-2309-CO	2000	Fire	HIGH MEADOWS FIRE	Jefferson

Declaration Number	Year Declared	Incident Type	Declaration Title	County
DR-385-CO	1973	Flood	HEAVY RAINS, SNOWMELT AND FLOODING	Jefferson
DR-385-CO	1973	Flood	HEAVY RAINS, SNOWMELT AND FLOODING	Adams
DR-261-CO	1969	Flood	SEVERE STORMS & FLOODING	Adams
DR-261-CO	1969	Flood	SEVERE STORMS & FLOODING	Jefferson
DR-200-CO	1965	Tornado	TORNADOES, SEVERE STORMS & FLOODING	Adams

Source: Fema.gov

The State of Colorado has received 22 Presidential major disaster declarations between 1965 and 2022. Ten of the state's declared disasters have been flooding related, 6 were related to wildfires and 3 were related to severe storms. (FEMA 2023)

The following flame chart indicates the risk rating of Westminster’s natural hazards relative to one another. This subjective assessment is based on community and stakeholder concerns and input. Please see Appendix B for a summary of the scoring methodology.

Figure 4-5 Natural Hazard Risk and Relative Ranking Summary

Natural Hazard Relative Risk Rating							
Likelihood	Most	E	<ul style="list-style-type: none"> • Windstorm 	<ul style="list-style-type: none"> • Swelling Soil 	<ul style="list-style-type: none"> • Severe Winter Storm 	<ul style="list-style-type: none"> • Invasive & Noxious Species • Severe Summer Storms 	<ul style="list-style-type: none"> • Climate Change
	D			<ul style="list-style-type: none"> • Open Space Fire (Wildfire) 	<ul style="list-style-type: none"> • Extreme Cold 	<ul style="list-style-type: none"> • Flooding • Wind Driven Fire 	
	C					<ul style="list-style-type: none"> • Extreme Heat 	<ul style="list-style-type: none"> • Epidemic/Pandemic
	B				<ul style="list-style-type: none"> • Erosion, Deposition and Turbidity • Tornado 	<ul style="list-style-type: none"> • Earthquake 	<ul style="list-style-type: none"> • Drought and Water Security
	A					<ul style="list-style-type: none"> • Geomagnetic Storm 	<ul style="list-style-type: none"> • Dam Failure
Least			1	2	3	4	5
			Lowest		Consequences		Highest

After evaluation of these hazards during the risk assessment process and based on changes in available data and HMPC consensus, several hazards reflected in the chart above have been shifted to different significance levels since 2018. Windstorm, swelling soils, severe winter storms, extreme cold, extreme heat, geomagnetic storms, pandemic, tornado, flooding, invasive and noxious species, severe summer storms, climate change, and drought have all remained in their original placements as in 2018. Earthquake has moved up in its likely perceived consequences of occurrence but has remained as a hazard with a very low likelihood of occurring. Erosion, Deposition, and Turbidity has been moved down in both its likelihood and consequences rating, after discussion on this hazard led to consensus that its impacts are not to the same scale as other natural hazards and that this hazard falls more within the realm of water supply and quality issues than hazard mitigation. The greatest change has come in moving open space and wind-driven fires up in its consequences and overall significance rating. This is largely due to discussions surrounding recent events in the front range, specifically the Marshall Fire, which significantly changed the paradigm around the potential for urban interface fires in Colorado, as well as what was generally viewed as the possible extent of impacts.

Further discussion on the assessment of each hazard listed above are found in the chapters that follow.

4.3 Natural Hazards Profile and Vulnerability

4.3.1 Climate Change

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Climate Change	E	5	5	10	E5*

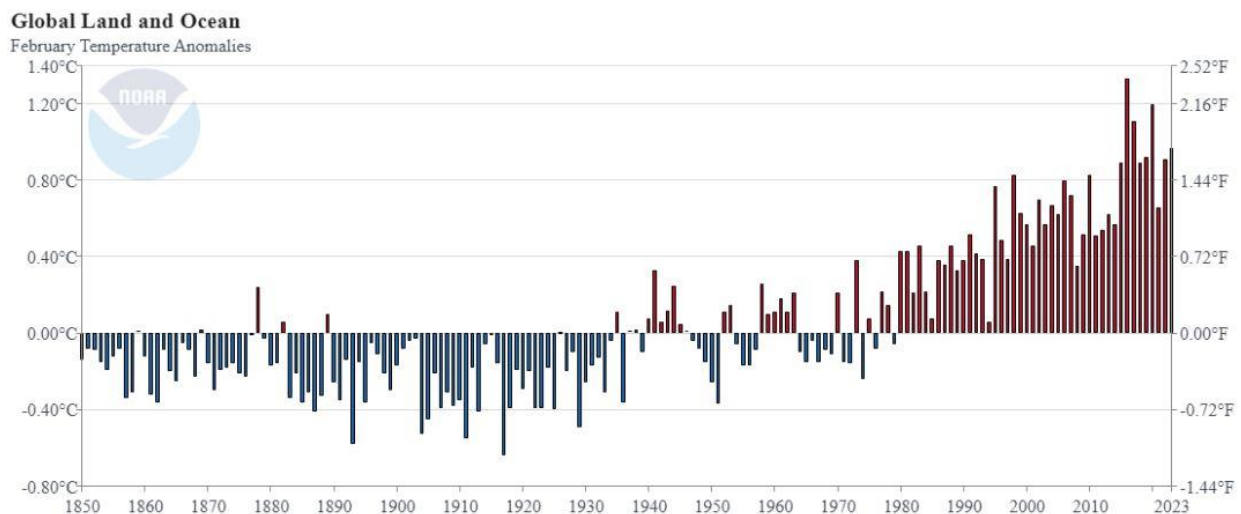
*Note: Individual risk rating was done based on the information provided in the hazard description and vulnerability assessment and does not consider the hazard relative to other hazards. Individual hazard scores may not be the same as the scores in 4.16.

Hazard/Problem Description

Climate change is an important phenomenon to evaluate in hazard mitigation planning. It is important to understand the distinction between weather and climate, and the interplay between the two. According to NOAA, “weather is what you experience when you step outside on any given day...it is the state of the atmosphere at a particular location over the short-term. Climate is the average of the weather patterns in a location over a longer period of time”. The climate changes as a result of both natural variations in global processes, and also from human activities, specifically the emission of greenhouse gases through the burning of fossil fuels. The paleoclimatic record of the past 2,000 years includes a previous warm anomaly in the northern hemisphere (950-1250) and a “Little Ice Age,” (1450-1850). The first decade of the 21st century was the warmest recorded since weather record keeping began. The years between 1983 and 2012 were assessed to have been the warmest 30-year period of the last 800-1400 years.

February 2023 was the fourth-warmest February for the globe in NOAA’s 174-year record and was about 1.75°F above the 20th-century average of 53.9°F. Additionally, February 2023 also marked the 528th consecutive month where global temperatures were above the 20th-century average.

Figure 4-6 Global Land and Ocean February Temperature Anomalies, 1850-2023

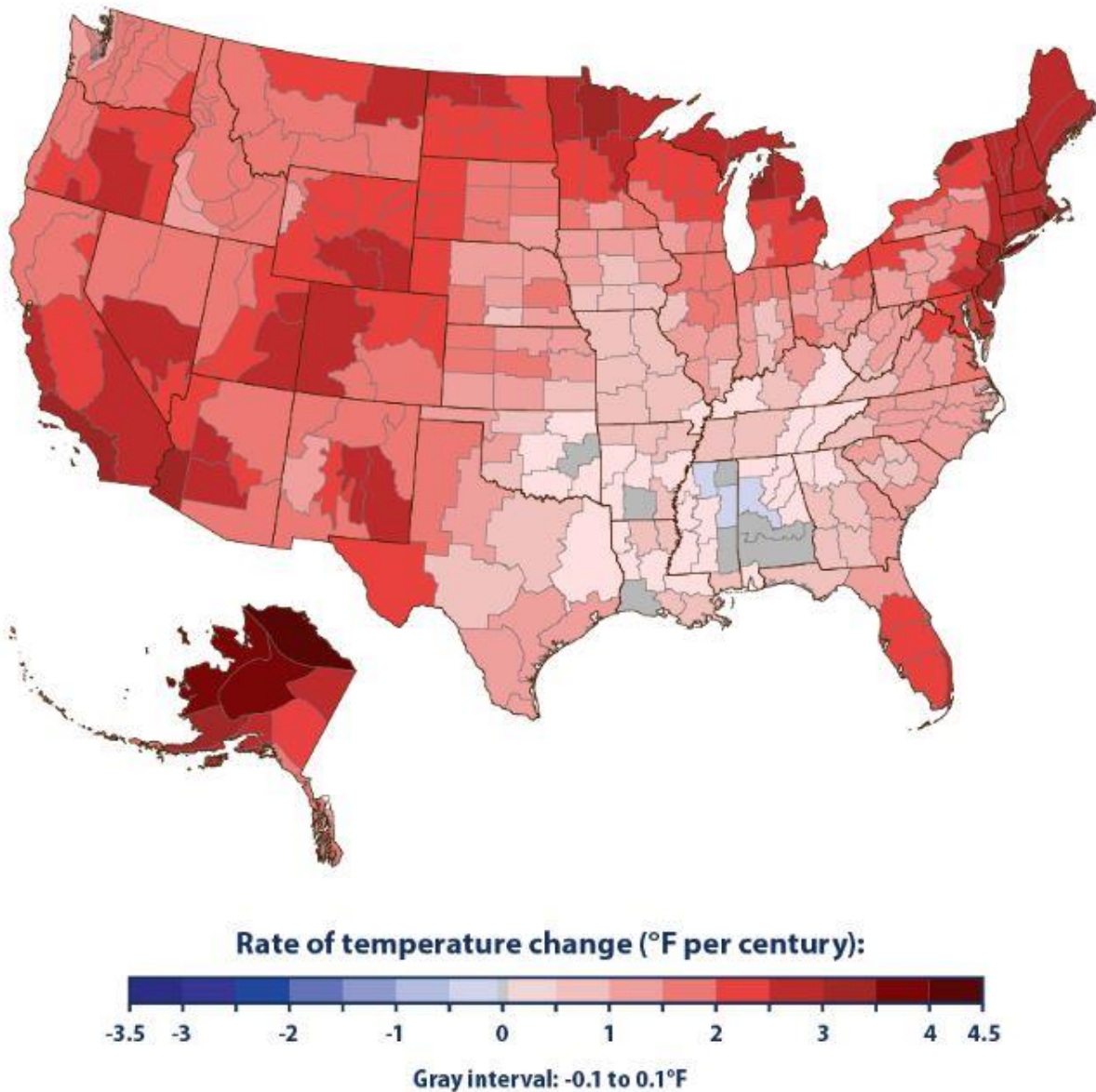


Source: NOAA Monthly Global Climate Report, <https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202302>

Global surface temperatures in 2022 were the sixth warmest since official records began in 1880. The ten warmest years since 1880 have all occurred since 2010. The changes in average temperatures have far reaching implications for the frequency and severity of natural hazards, driving heat waves, severe

storms, and droughts to worsen in their intensity and length, increasing the length of the typical wildfire season, and introducing new variables in the spread of infectious diseases, among many other impacts. In addition to the historic record of major regional droughts in the 1930s and the 1950s, the paleo record includes “megadroughts” that lasted over 30 years in the 11th-12th centuries and were probably tied to the decline of the Anasazi and Pueblo peoples of the Colorado Plateau (Howard 2015).

Figure 4-7 Rate of Temperature Change in the United States, 1901-2021



Source: U.S. Environmental Protection Agency, Climate Change Indicators, <https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature>

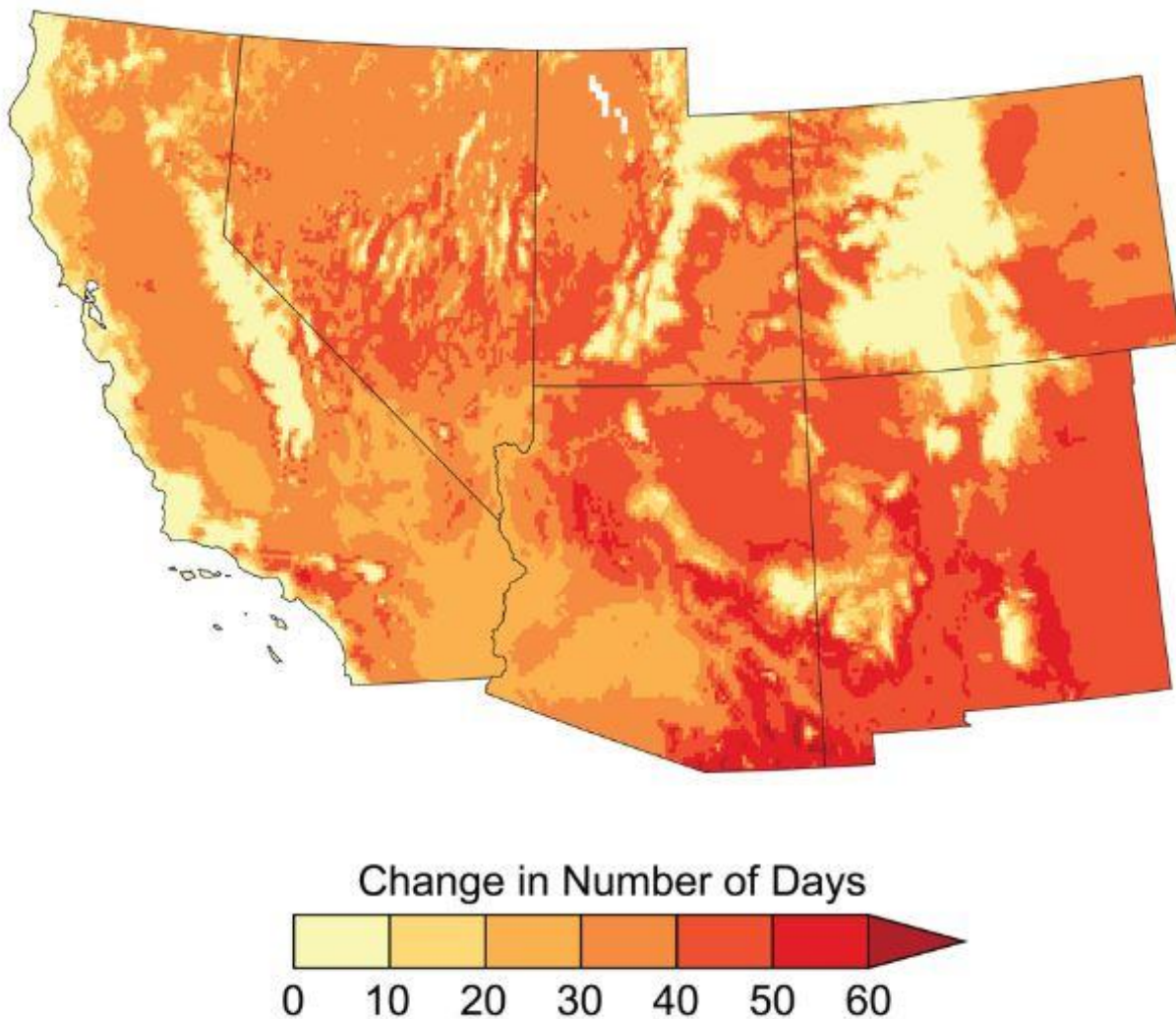
Southwest Region Climate Trends

According to the Fourth National Climate Assessment, the Southwest region of the United States contains the hottest and driest climate in the nation. Regional average temperatures are projected to rise by 2.5F to 5.5F degrees between 2041-2070 and by 5.5 to 9.5 degrees between 2070-2099 with continued growth in global CO₂ emissions. A reduction in CO₂ emissions could result in a smaller increase in temperatures. As

a result of increasing temperatures, snowpack will likely see a significant decline in the coming decades. An important implication of the changes in climate averages is the changes in extreme events and outliers that come with.

Figure 4-8 below shows the projected increase in the number of days with extreme heat per year in the Southwest, from 2036-2065.

Figure 4-8 Projected Increases in Extreme Heat



Source: Fourth National Climate Assessment

The Fourth National Climate Assessment includes detailed discussions of the impacts of Climate Change in the Southwest on water resources, the natural ecosystems, the California coast, Indigenous Peoples, energy, food, and human health. Some of the key takeaways for the region as a whole include:

- Reductions in water volume in both Lake Powell and Lake Mead, as well as reductions in average snowpack, increasing the risk for water shortages and the severity of droughts across the Southwest;
- Increased exposure to hotter temperatures and heat waves, and with this, increased levels of ground-level ozone and particulate matter air pollution, increased rates of heat-induced illness, and a

disproportionate number of West Nile virus, plague, hantavirus pulmonary syndrome, and Valley fever cases;

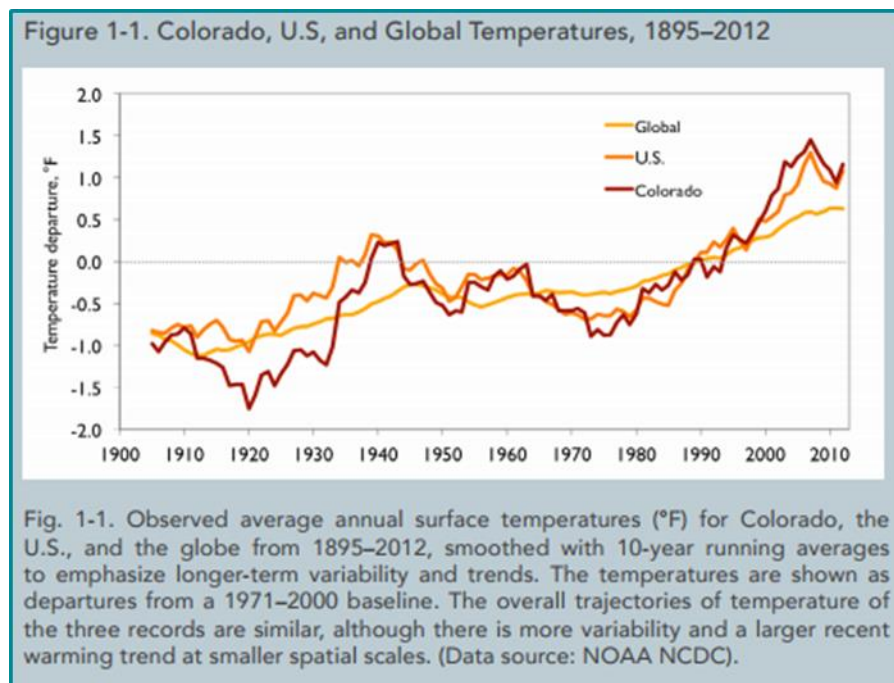
- Tree death in mid-elevation conifer forests doubled from 1955 to 2007 due, in part, to climate change. This also contributed to wildfires burning nearly twice the area between 1984 and 2015 that would have otherwise burned had climate change not occurred, according to some analyses;
- Agricultural irrigation accounts for approximately three-quarters of water use in the Southwest region, which also grows half of the fruits, vegetables, and nuts and most of the wine grapes, strawberries, and lettuce for the United States, signifying a significant vulnerability in the country's food network; and
- The region recorded more warm nights and fewer cold nights between 1990 and 2016, as well as an increase of 4.1°F for the coldest day of the year.

Climate Change in Colorado

Colorado has warmed substantially over the past 30 years, and even more so over the past 50 years. Future estimates project that by the year 2050 temperatures in Colorado could rise an additional 2.5 to 5°F. This means that extreme outliers in seasonal temperatures could become the new normal in coming years. According to the Colorado Water Conservation Board, increasing temperatures in Colorado could also bring shifts in snowmelt runoff, water quality concerns, stressed ecosystems and transportation infrastructure, impacts to energy demands, and extreme weather events that can impact air quality and recreational opportunities. The 2014 Climate Change in Colorado report by the Colorado Water Conservation Board provided the following observations:

- Colorado has warmed by 2 degrees F during the past 30 years and 2.5 degrees Fahrenheit during the past 50 years.
- There are no clear long-term trends in precipitation.
- Snowmelt and peak runoff have shifted earlier in the spring by 1-4 weeks over the past 30 years.
- There is a trend towards severe soil moisture drought over the past 30 years.
- Tree ring studies show multiple droughts prior to 1900 that were more severe and sustained than any in the recent observed record (Lukas 2014).

Figure 4-9 Colorado, U.S. and Global Temperature Changes 1895-2012



Source: US Global Change Research Program GlobalChange.gov 2014

Westminster and Climate Trends

The following tables are based on information recorded at the Northglenn, Colorado NWS weather recording station between 1984 and April 2023, and indicate the area of the City of Westminster is becoming warmer and dryer punctuated by extreme snow and rain events.

Table 4-6 Monthly Highest Max Temperatures for Northglenn, CO NWS Station, 1984-2023 (°F)

Month	Monthly Mean Maximum Temperature (°F)	Record High Temperature (°F)	Date of Record	# of Days with Maximum Temperature ≥ 90 °F
January	46.9	77	1/2/1997	0
February	48.2	83	2/11/2017	0
March	56.4	85	3/31/2010	0
April	63.7	90	4/30/1992	0
May	72	101	5/29/2003	1.3
June	84.3	105	6/29/2018	9.6
July	90.3	108	7/22/2005	18.2
August	88	110	8/2/2008	15
September	79.9	102	9/3/2019	5.6
October	66.5	92	10/3/2005	0.1
November	54.8	84	11/10/2019	0
December	46.2	77	12/5/2007	0

Source: NOAA-NWS, Western Regional Climate Center

Table 4-7 Monthly Lowest Min Temperatures for Northglenn, CO NWS Station, 1984-2023 (°F)

Month	Monthly Mean Minimum Temperature (°F)	Record Low Temperature (°F)	Date of Record	# of Days with Maximum Temperature ≤ 32 °F
January	19	-15	1/31/1985	4.2
February	19.9	-17	2/3/1996	4.4
March	27.7	-5	3/2/2002	1.6
April	34.4	6	4/12/1997	0.4
May	43.7	20	5/2/2013	0
June	53	34	6/1/1988	0
July	58.2	43	7/13/1987	0
August	56.5	41	8/6/1986	0
September	48	18	9/29/1985	0
October	36.4	4	10/31/2019	0.5
November	26.6	-6	11/24/1993	2
December	18.5	-24	12/22/1990	4.3

Source: NOAA-NWS, Western Regional Climate Center

Monthly Temperature Summary:

- Average hottest month: July.
- Highest temperature: 110 degrees.

- Average coldest month: January.
- Record low temperature: -24.
- Monthly high trend: 10 of 12 monthly record highs recorded since 2002.
- Monthly low trend: 9 of 13 monthly record lows recorded before 2002.
- Conclusion: We are seeing more frequent monthly record highs since 2002. We are seeing fewer record low highs since 2002. Overall, we appear to be warming.

Table 4-8 NORTHGLENN, CO, Period of Record General Climate Summary – Precipitation (Period of Record: 09/01/1984 – 04/04/2023)

Month	Mean Precipitation (in)	High Precipitation (in)	High Precipitation Year	Precipitation Low (in)	Low Precipitation Year	1-Day Max Precipitation (in)	Record Date	Mean Total Snowfall (in)	High Total Snowfall (in)	High Total Snowfall Year
January	0.47	1.64	2019	0	2003	0.68	1/12/2019	6.4	16.4	2007
February	0.57	2.17	2015	0	1992	0.86	2/3/2012	7.6	30.4	2015
March	1.23	4.76	2003	0.01	2012	2	3/27/2003	8.3	33.4	2016
April	1.81	6.49	1999	0.02	2002	2.27	4/24/1997	5.9	17.6	2013
May	2.38	6.49	2015	0.43	2006	2.2	5/29/1990	1	6.2	2001
June	1.5	4.16	1987	0.1	2012	1.55	6/12/2010	0	0	1985
July	1.76	4.47	2014	0	2008	2.15	7/24/2004	0	0	1985
August	1.31	3.57	2008	0.02	1985	2.45	8/24/1992	0	0	1985
September	1.11	6.36	2013	0	1992	1.88	9/12/2013	0.3	6	1985
October	1.01	3.37	1984	0	2003	1.57	10/4/1984	2.9	15.6	2019
November	0.68	2.59	2015	0	1984	1.05	11/26/2019	6.4	27.8	1991
December	0.53	2.76	2006	0	2002	1.49	12/21/2006	7.2	31.2	2006

Source: NOAA-NWS, Western Regional Climate Center

Precipitation Summary

- Wettest Month on Average: May, 2.38 inches.
- Wettest Month on Record: Tie, April 1999 and May 2015, 6.49 inches.
- Monthly High Precipitation Trends: 9 of the 12 wettest months on record since 2003.
- Monthly Low Precipitation Trends: 8 of 12 lowest precipitation months occurred after 2000, little or no precipitation in any given month is not unusual for Westminister.
- Snowiest Month on Average: March, 8.3 inches.
- Snowiest Month on Record: March 2016, 33.4 inches.
- Maximum Snowfall Trends: 7 of 12 monthly snow records were set after 2000.
- Conclusion: Overall, Westminister has been dryer since 2000, but extreme precipitation events seem to be increasing. Although extreme snowfall events have occurred since 2000, overall snowfall appears to be decreasing. “These projections are generally consistent within the clear scientific consensus that across most of the United States heavy precipitation events have become heavier and more frequent, and with further climate change are expected to increase across the entire country, even in areas where total precipitation is expected to decline. This is because of the basic principle of physics that warmer air can hold more moisture, and so higher temperatures should lead to more precipitation extremes.” (Stephen Saunders 2016).

Vulnerability Summary

Colorado and the Southwest are the warmest and driest part of the United States. Water has been, and will continue to be, a determining factor in the growth and development of the city and the Front Range. Persistent warming and drying trends and the potential of major droughts or a megadrought (20-50 years) would have drastic impacts that could result in extreme events becoming more common and more extreme. A persistently warm and dry climate could stress the forests that characterize the watershed upon which the city depends and make these critical areas more susceptible to wildfire and insects. Reduced snowpack will result in decreasing the availability and reliability of our water supply. (GlobalChange.gov 2014) Climate change could endanger or redefine our urban landscapes, lawns, trees, and open space. Higher temperatures and longer warm periods/heat waves are expected to result in increased energy demands, stress on critical infrastructures and endanger at-risk populations such as the elderly. If the climatic trends of the past 30 years continue as predicted, many of the natural hazards in this study could be more significant than the historic record indicates.

Each of the following hazard sections in this HMP includes a more specific analysis of the expected impacts of climate change on the mechanics of that hazard, such as changes in intensity, frequency, magnitude, and vulnerability of the population, based on the best available science.

4.3.2 Drought and Water Security

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Drought	B	5	5	4	B5

Hazard/Problem Description

Drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. Drought is a temporary aberration from normal climatic conditions; thus, it can vary significantly from one region to another. Drought is different than aridity, which is a permanent feature of climate in regions where low precipitation is the norm, as in a desert. (NOAA, Drought Public Fact Sheet 2008)

Drought is one of the most serious and complex hazards we face. Although trends in precipitation, snowmelt and retention may provide indicators, the onset of a prolonged drought will be ambiguous. The 2013 State of Colorado Drought Mitigation and Response Plan documents the recurrent state-wide drought hazard, its complexity, and its regional effects:

- Meteorological drought is usually defined by a period of below-average precipitation.
- 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.

Of these effects, hydrological and socioeconomic are the most pertinent to the City of Westminster. As indicated in the Drought Impact Reporter of Colorado (1935-2013), the city is among the areas of greatest impact historically.

Westminster is dependent on snow melt from Bear/Clear and Boulder creeks for its water. These are relatively small watersheds which makes them more vulnerable to drought and degradation due to wildfire and invasive/noxious species. Most of the city is within the headwaters of Big Dry Creek which is a small tributary of the South Platte River Basin.

Due to the city’s geographic location in a semi-arid climate, the area has experienced periods of drought. History suggests severe and extended droughts are inevitable and part of the natural climate cycle. The Southwest United States experienced significant droughts in the 1930s, 1950s and the paleoclimate records show severe megadroughts that were at least 50 years long. (GlobalChange.gov 2014) The USDA issued Disaster Declarations for Adams and Jefferson counties in 2002, 2011, 2012 and 2013. (DHSEM 2013) The recurrence of drought is inevitable, roughly once in each decade, but its duration is difficult to predict.

The U.S. Drought Monitor classifies droughts into different categories, from D0 (Abnormally Dry) to D4 (Exceptional Drought). Periods of dryness are classified in one of these categories as the drought’s life cycle is tracked. Colorado has experienced D4 conditions, and it is possible that Westminster could experience this upper end of the Drought Monitor extent range.

Future droughts will be a combination of both increasing demand and periodic, prolonged reductions in the availability of precipitation. The South Platte Basin encompasses Colorado’s most densely populated communities and is expected to significantly increase its population by 51% between 2000 and 2020. (C. W. Board 2017)

Past Occurrences

Drought is a regular and widespread occurrence in the State of Colorado. Table 4-9 lists the most significant of the instrumented period (which began in the late 1800s). Although drought conditions can vary across the state, it is likely that the planning area was affected by most of these dry periods.

Table 4-9 Historical Dry and Wet Periods in Colorado

Date	Dry	Wet	Duration (years)
1893-1905	X		12
1905-1931		X	26
1931-1941	X		10
1941-1951		X	10
1951-1957	X		6
1957-1959		X	2
1963-1965	X		2
1965-1975		X	10
1975-1978	X		3
1979-1999*		X	20
2000-2006*	X		6
2007-2010		X	3
2011-2013	X		2
2018	X		1
2020-Current	X		Ongoing

Source: McKee, et al. *Modified for the Colorado State Drought Plan in 2018 based on input from the Colorado Climate Center and US Drought Monitor.

Several times since the late 1800s, Colorado has experienced widespread, severe drought. The most dramatic occurred in the 1930s and 1950s when many states, Colorado included, were affected for several years at a time. There have been seven multi-year droughts in Colorado since 1893. Below are past droughts in Colorado:

- **The 1930s Drought:** The Dust Bowl drought severely affected much of the United States during the 1930s.
- **The 1950s Drought:** During the 1950s, the Great Plains and the southwestern US withstood a five-year drought, and in three of these years, drought conditions stretched coast to coast. The 1950s drought was characterized by both decreased rainfall and excessively high temperatures. The area from the Texas panhandle to central and eastern Colorado, western Kansas, and central Nebraska experienced severe drought conditions.

- **The 1977 Drought:** During 1976 and 1977, the state experienced record-low stream flows at two-thirds of the major stream gages, records that held until the 2002 drought. Additionally, in the 1976-1977 drought the Colorado ski industry estimated revenue losses at \$78.6 million; agriculture producers incurred higher crop production costs due to water supply shortages; and numerous municipalities were forced to impose water use restrictions on their customers. The state's agriculture producers and municipalities received over \$110 million in federal drought aid because of the 1976-1977 drought.
- **1980-1981 Drought:** Short-lived, beginning in the fall of 1980 and lasting until the summer of 1981.
- **1994 Drought:** Significant impacts reported included an increase in wildland fires state-wide, loss to the winter wheat crops, difficulties with livestock feeding, and impacts to the State's fisheries.
- **1996 Drought:** The Governor issued an Executive Order on July 29th proclaiming a Drought Disaster Emergency Declaration for fifteen counties.
- **2002 Drought:** The drought of 2002 is considered the most intense drought on record for Colorado. State-wide snowpack was at or near all-time lows. What made 2002 so unusual was that all of the State was dry at the same time. By all accounts, soil moisture was nearly depleted in the upper one meter of the soil profile over broad areas of Colorado by late August 2002. In over 100 years of record, 2002 was clearly the driest year on record based on stream flow. This was an extremely dry year embedded in a longer dry period (2000-2006). These conditions were rated exceptional by the US Drought Monitor and were the most severe drought experienced in the region since the Dust Bowl. The impacts of this drought are discussed above under Magnitude/Severity.
- **2012 Drought:** Even though 2011 was very wet across northern Colorado, the extreme drought during this time in Texas, New Mexico, and Oklahoma was also felt in the Rio Grande and Arkansas Basins in Colorado. This trend continued in those basins as 2012 began, but also increased in breadth across the rest of Colorado. Based on the US Drought Monitor, approximately 50% of Colorado was already under drought conditions at the beginning of 2012. Drought conditions and a period of extremely hot temperatures in June 2012 contributed to very dry forests, creating the conditions that led to two of Colorado's most destructive wildland fires: The High Park Fire in northern Colorado and the Waldo Canyon Fire near Colorado Springs. Drought conditions also exacerbated the Lower North Fork Fire in Jefferson County in March of 2012. Reservoir levels in many portions of the State helped abate some of the drought impacts seen in 2011-2013. Had the reservoir levels not been at levels sufficient for carryover storage into 2012 (due to record breaking high snowpack in 2011) in many river basins, many of the impacts discussed above may have been worse.

Geographical Area Affected

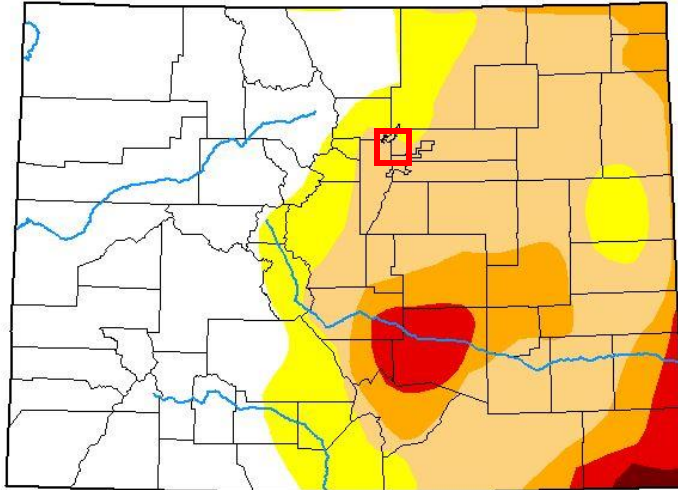
Drought is regional in nature and can occur anywhere in the State, affecting all or part of the planning area at any given time. Westminster's water supply is largely sourced from rivers and reservoirs fed by mountain snowpack; thus, winter drought conditions in nearby Summit, Grand, Boulder, Park, and Jefferson Counties can have consequences for Westminster. The geographic extent is **extensive**. Adams County data has been used as the majority of the planning area is in that County.

Figure 4-10 below shows the US Drought Monitor for Colorado as of April 25, 2023. Below that, Figure 4-11 shows the US Drought Monitor as of July 13, 2023, when the entire state was no longer in drought. The approximate location of the City of Westminster is indicated by a red square. As shown in the figure, the planning area is currently experiencing moderate drought conditions.

Figure 4-10 US Drought Monitor Snapshot, April 25, 2023

**U.S. Drought Monitor
Colorado**

April 25, 2023
(Released Thursday, Apr. 27, 2023)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	44.07	55.93	44.01	14.50	4.52	0.43
Last Week <small>04-18-2023</small>	44.07	55.93	44.01	14.50	4.52	0.43
3 Months Ago <small>01-24-2023</small>	43.18	56.82	35.58	11.18	1.87	0.04
Start of Calendar Year <small>01-03-2023</small>	39.97	60.03	33.83	12.28	1.91	0.01
Start of Water Year <small>09-27-2022</small>	15.46	84.54	45.65	15.47	3.73	0.57
One Year Ago <small>04-26-2022</small>	0.00	100.00	88.57	47.62	4.46	0.53

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

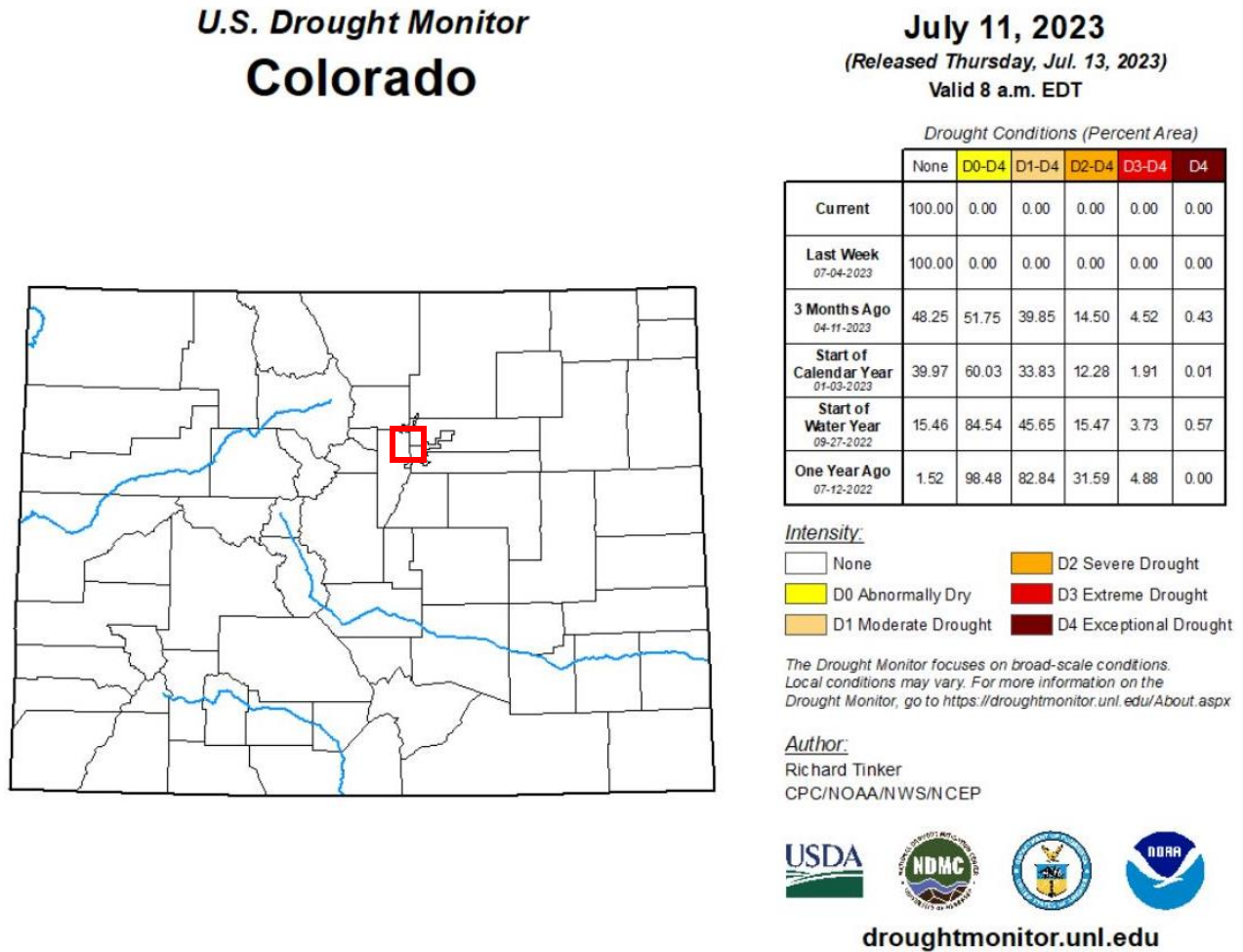
Author:

Richard Tinker
CPC/NOAA/NWS/NCEP



droughtmonitor.unl.edu

Figure 4-11 US Drought Monitor Snapshot, July 13, 2023



Magnitude/Severity

The **Palmer Drought Severity Index (PDSI)** was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. Over time it has become the semi-official drought index for risk assessment and hazard analysis. The Palmer Index is most effective in determining long term drought—a matter of several months—and is not used for short-term forecasts (a matter of weeks). It uses a 0 as normal conditions, and drought is shown in terms of negative numbers; for example, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. The following table provides an overview of the Palmer Index compared to other drought classification systems. The return period is related to how often the type of drought typically occurs. For example, a minor drought occurs every 3-4 years.

Table 4-10 Drought Severity Classifications

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought Monitoring Indices		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures;	-0.5 to -0.7	D0	-1.0 to -1.9

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought Monitoring Indices		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
		fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.			
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing, or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44 +	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies	Less than -2	D4	-5.0 or less

Source: National Drought Mitigation Center

The U.S. Drought Monitor provides a summary of drought conditions across the United States and Puerto Rico. Often described as a blend of art and science, the Drought Monitor map is updated weekly by combining a variety of data-based drought indices and indicators as well as local expert input into a single composite drought indicator.

Drought impacts in the planning area can be wide-reaching: economic, environmental, and societal. Although the agricultural industry in the City is limited, it is expected to experience some crop losses as well as an increase in livestock feeding expenses and potentially livestock deaths. The Denver Mountain Parks may see an increase in dry fuels and associated wildland fires, and the City could experience some loss of tourism/recreation revenue. Water supply issues for municipal, industrial, and domestic needs will be a concern for the entire City. Lawn and tree impacts in urban areas could result from water restrictions. Vulnerability increases with consecutive winters of below-average snowpack. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. It also increases the wildland fire hazard and even landslide hazard.

Frequency/Likelihood of Occurrence

According to information from the Colorado Drought Mitigation and Response Plan, Colorado was in drought for 50 of the past 126 years (1893-2018). Based on this record of past occurrences, there is a 39.7% chance that a drought will happen in Colorado in any given year, and a drought can be expected somewhere in the state every 2.5 years. According to the US Drought Monitor, since 1980 Adams County has experienced 271 non-consecutive weeks of at least severe level drought conditions. If future occurrences continue to follow recent decades, Adams County has a 12% chance of experiencing severe or worse drought conditions. Short-duration droughts are likely, but longer periods of intense drought are common.

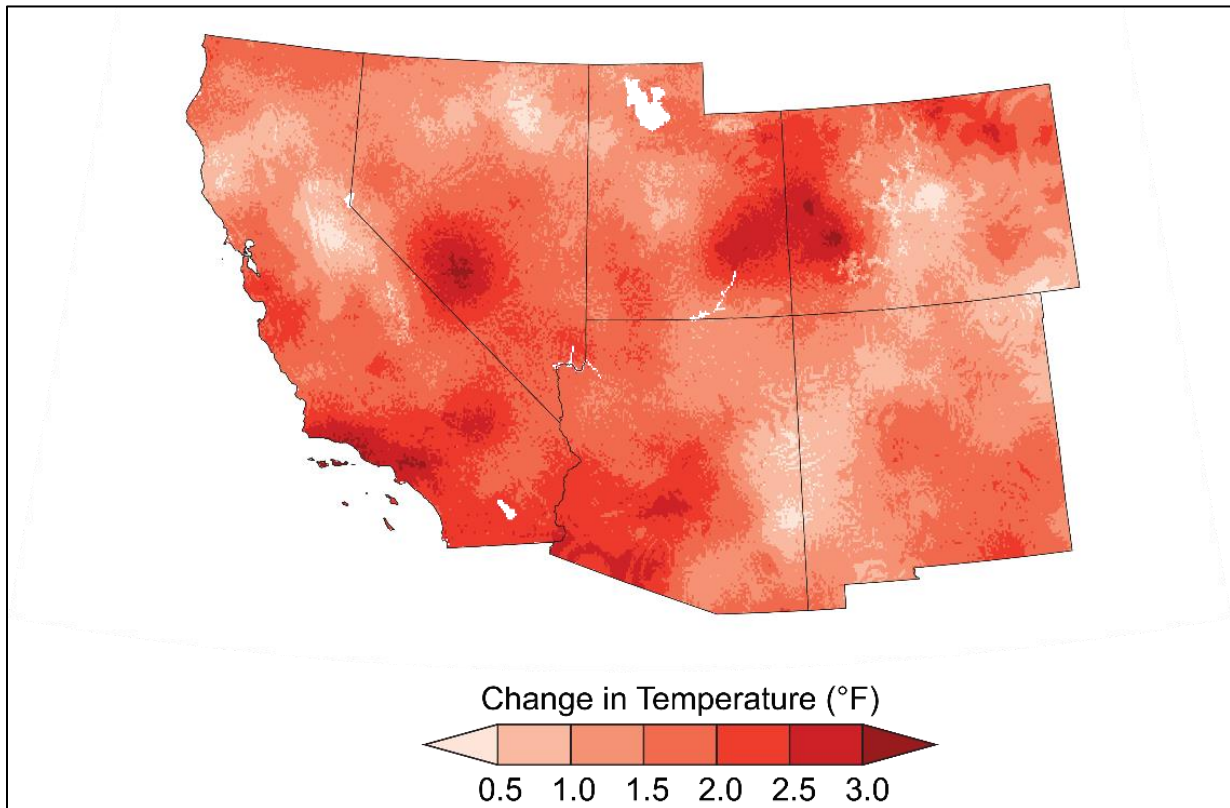
Climate Change Considerations

Current climate change projections suggest that drought conditions may become even more common in the future due to a variety of factors, including higher temperatures and increased evapotranspiration, reduced snowpack from less snowfall and earlier spring melt, and severe soil moisture drought.

Research cited in the Fourth National Climate Assessment indicates that average temperatures have already increased across the Southwest and will likely continue to rise. Figure 4-12 shows the difference

between the 1986-2016 average temperature and the 1901-1960 average temperature, with the planning area circled. This trend toward higher temperatures is expected to continue and would cause more frequent and severe droughts in the Southwest as well as drier future conditions and an increased risk of megadroughts—dry periods lasting 10 years or more. Additionally, current models project decreases in snowpack, less snow and more rain, shorter snowfall seasons, and earlier runoff, all of which may increase the probability of future water shortages (Gonzalez et al., 2018).

Figure 4-12 Change in Average Temperature Across the Southwest, 1901-1960 vs 1986-2016



Source: Fourth National Climate Assessment

Vulnerability Assessment

The primary potential impact of drought on Westminster is a reduction in the quantity and quality of its water supply. Drought also kills and stresses plants increasing their susceptibility to wildfire and invasive/noxious species. Drought can have catastrophic economic, social, and ecological consequences. (CRS study) Drought can impact municipal reservoir storage and lead to water shortages. Water restrictions could impact suburban landscapes (lawns, gardens, and trees) and evaporative cooling (a significant form of cooling for our residents and businesses). A prolonged drought has the potential to significantly impact on the quality of life, economy, and overall environment of the city.

People

The historical and potential impacts of drought on populations include agricultural and recreation/tourism sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. Other public health issues can include impaired drinking water quality, increased incidence of mosquito-borne illness, an increase in wildlife-human confrontations and respiratory complications as a result of declined air quality in times of drought.

Drought may cause health problems related to low water flows and poor water quality; it may also cause health problems due to an excess of dust and poor air quality. According to the Centers for Disease Control, viruses, protozoa, and bacteria can pollute both groundwater and surface water when rainfall decreases. Acute respiratory and gastrointestinal illnesses are more easily spread from person-to-person, bacteria can more easily contaminate and cause infectious diseases, and recreational waters can become infected with pathogens that thrive in the shallow warm waters that exist during drought conditions. Generally, drought may require conservation of water resources, which could mean that water use is restricted to critical uses; this could impact how people use water on a daily basis. Those who are young, old, and suffering from chronic diseases could be especially vulnerable to the impacts of drought.

Drought can affect people's physical and mental health. For those economically dependent on a reliable water supply, drought may cause anxiety or depression about economic losses, reduced incomes, and other employment impacts. Drought may also cause health problems due to poorer water quality from lower water levels.

Aside from direct health impacts, in extreme cases of drought, conflicts may arise over water shortages. People may be forced to pay more for water, food, and utilities affected by increased water costs.

Property

Drought does not typically have a direct impact on buildings, although an increase in expanding or collapsing soils could affect building foundations. Developed areas may experience damages to landscaping if water use restrictions are put in place; however, these losses are not considered significant. Drought can affect soil shrinking and swelling cycles and can result in cracked foundations and infrastructure damage.

Property owners could experience higher property expenses from water cost increases, water rights legal battles, utility services changing, etc.

Critical Facilities

The city's current water management practices have been shaped by snowmelt, the timing and duration of its runoff, the capacity of Standley Lake, current water-sharing agreements and our limited population. Factors such as earlier runoff seasons coupled with longer and warmer springs and summers, and a growing population will require changes in our storage capacity and water use practices. Our drought resilience will depend on the anticipation and management of not just supply and demand, but also the form of the precipitation, its natural flow/retention, our storage capacity, and our wise management of this essential natural resource to meet future demands.

Economy

Drought impacts on the natural environment of Westminster and Colorado as a whole, and the cascading impacts to the recreation sector could lead to less people visiting and spending money in the Front Range which could have a negative impact on the entire local economy.

The Colorado Water Conservation Board (CWCB) maintains a Future Avoided Cost Explorer (FACE) tool, which estimates annual damages from drought and other hazards under various climate change and population growth scenarios. According to FACE analysis, Adams County could potentially experience \$11 million in losses due to drought conditions under medium population growth and moderate climate scenarios.

Historical, Environmental, Cultural Resources

In addition to (and in conjunction with) drought, the city's overall water security is endangered by several factors that affect the overall health of the watersheds of the Front Range. These essential biomes are susceptible to degradation due to potential contamination from the historic mine locations, the impact of potential wildfires and invasive species. Any factor (or combination of factors) that degrades the health of our watersheds has the potential to reduce the quantity and quality of our raw water and can have impacts on the city's water treatment and distribution system.

The Rocky Flat nuclear weapons site is approximately 2.5 miles west of the city. Cleanup of this site was completed in 2005 and Woman Creek Reservoir was constructed to interrupt any potential runoff from entering the city's water supply. The Department of Energy retains management of 1,308 acres of the site due to the presence of residual contamination and continued groundwater treatment.

The Central City & Idaho Springs Mining District is a superfund site (in Clear Creek and Gilpin counties) that has the potential to impact the city's water supply. This superfund site covers 400 square miles of the drainage basin of Clear Creek which has been affected by a number of mines. The state and EPA are managing clean up and mitigation efforts which include the Argo Tunnel Water Treatment Facility which prevents 1,200 pounds of metals per day from entering Clear Creek. If the flow control measures in the Argo Tunnel were overwhelmed or fail, the water supply of about 250,000 people (including Westminster) would be compromised. (Colorado Department of Public Health & Environment 2023)

The Western Balsam Bark Beetle is endemic to the Rocky Mountain region and has entered the upper Clear, Bear and Ralston basins. Our forests have been stressed by persistent and seasonal droughts in recent years making them more susceptible to a wide range of other invasive species as well as large wildfires. These hazards, separately and in combinations, present a significant ongoing hazard to the quality and availability of our water supply. Severe wildfires also damage the soil greatly delaying environmental restoration and increasing the erosion and turbidity.

Development Trends

The City of Westminster, as with most communities in the Front Range, is experiencing population growth in recent years, and trends show this continuing in the coming years as well. Drought vulnerability will increase with future population growth and development, as there will be increased demands for limited water resources. Water resources planning and water conservation that accounts for future development can play a role in mitigating drought impacts.

Adams County has a semi-arid climate, which means precipitation is already limited under normal climate conditions. Per the State's Drought Mitigation and Response Plan, all of Colorado depends on precipitation for its water supply. Additionally, public water supply is or may soon become inadequate for much of Adams County and its incorporated areas, especially in the face of development plans and pressures (Adams County <http://www.adcogov.org/news/h2-ohh%E2%80%A6>, 2019). A 2011 gap analysis done for the Colorado Water Conservation Board, shown in Figure 4-13, indicates that water demand may surpass supply as soon as 2025 in the South Platte Basin and 2030 in the Metro Basin (CDM, 2011). As the gap between water supply and water demand shrinks, departures from normal hydrologic conditions may be felt more easily in Adams County. Water rights issues further complicate this matter.

The Colorado Water Conservation Board FACE tool, mentioned above, also provides an assessment of the potential impacts of drought under various growth and climate scenarios. Impacts are reported in terms of expected annual damages: the expense that would occur in any given year if monetary damages from all hazard probabilities and magnitudes were spread out over time (units = 2019 dollars). The results for Adams County under a moderate climate change scenario and medium population growth are shown in Figure 4-14 below. The full details and analysis used for this report can be found in the FACE technical report:

https://dnrftp.state.co.us/CWCB/Climate/FACE_Hazards_Data/FACE_Hazards_TechnicalReport.pdf

Figure 4-13 CWCB Water Supply Gap Analysis

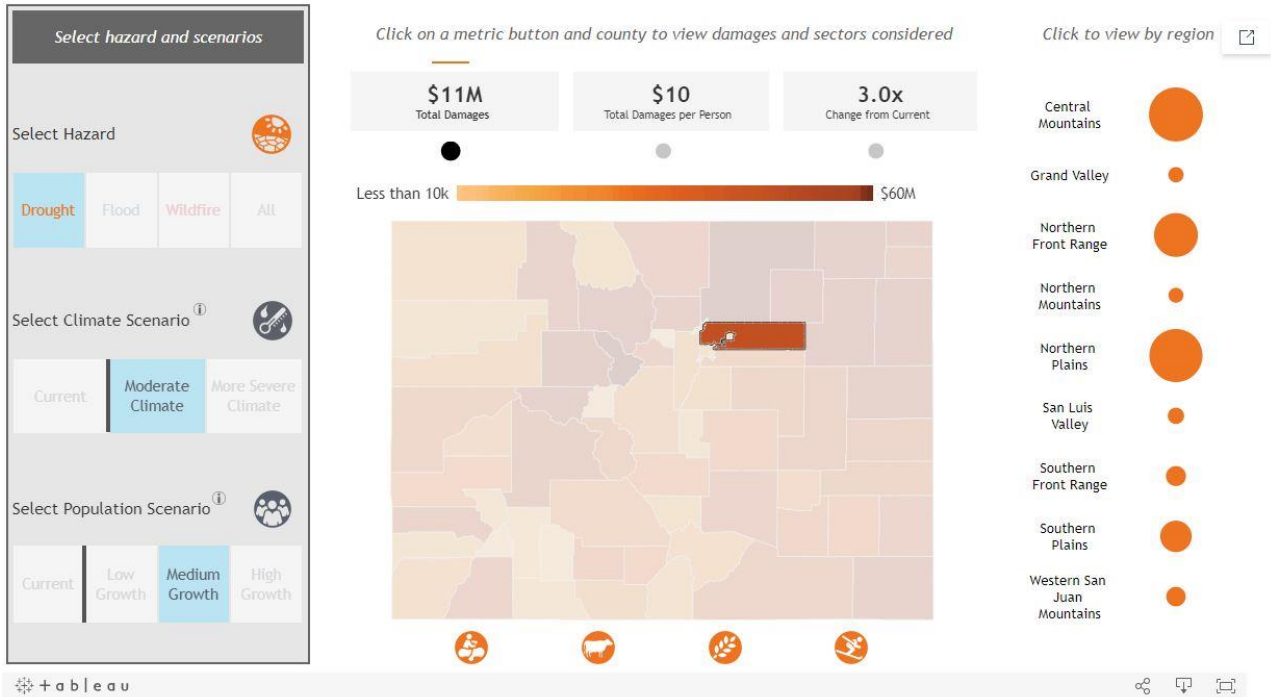
Municipal and Industrial Gap and Estimated Beginning Year for 100%, Inter basin Compact Committee (IBCC) Alternative Portfolio (Optimistic), and Status Quo Portfolio (Realistic) Scenarios

Basin/Area	Gap under 100% Scenario (AF)	Gap Begins	Gap when IPPs at IBCC Alternative Portfolio (Optimistic) Scenario (AF)	Gap Begins	Gap when IPPs at Status Quo Portfolio (Realistic) Scenario (AF)	Gap Begins
South Platte Basin	55,000	2040	110,000	2025	130,000	2025
Metro Basin	66,000	2045	130,000	2030	150,000	2030
Arkansas Basin	54,000	2040	64,000	2035	78,000	2035
Front Range ¹	150,000	2040	270,000	2030	320,000	2030
Colorado Basin	27,000	2040	33,000	2040	33,000	2040
Gunnison Basin	3,600	2045	5,200	2040	5,200	2040
Yampa - White Basin	36,000	2020	37,000	2020	37,000	2020
Southwest Basin	7,600	2040	12,000	2035	12,000	2035
Rio Grande Basin	2,800	2040	3,500	2040	3,500	2040
North Platte Basin	0	2055	0	2050	0	2050
Statewide	250,000	2040	390,000	2030	450,000	2030

1) Front Range includes South Platte Northern, Denver Metro, South Metro, Arkansas Urban Counties

Source: CWCB

Figure 4-14 Adams County CWCB FACE Tool Results - Drought



Source: Colorado Water Conservation Board, <https://cwcb.colorado.gov/FACE>

4.3.3 Earthquake

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Earthquake	B	4	2	3	B4

Hazard/Problem Description

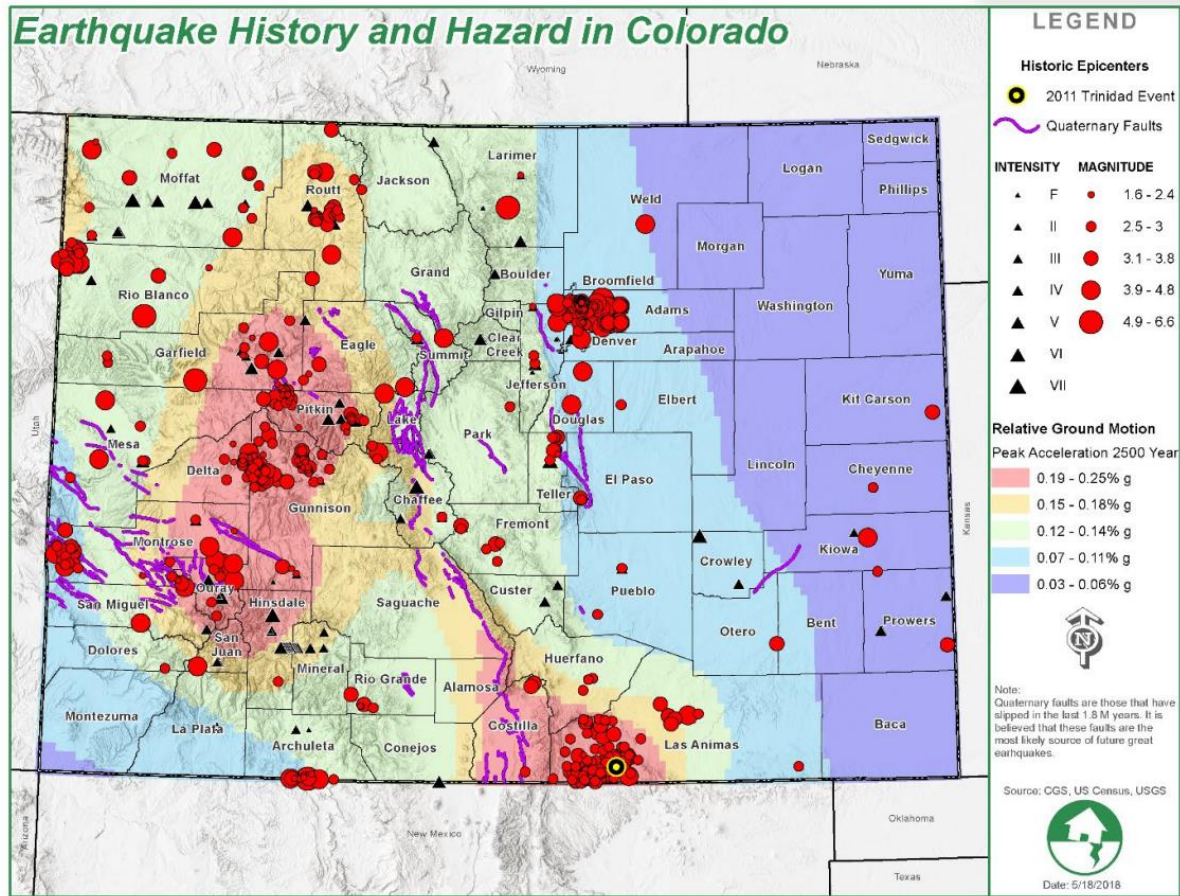
Earthquake is a term used to describe both the sudden slip on a fault and the resulting ground shaking and radiated seismic energy caused by the slip, or by volcanic or magmatic activity, or other sudden stress changes in the earth. (USGS 2012) The Golden Fault (approximately 10 miles west of Westminster) is the only proximate fault identified by the US Geological Survey (USGS). The Golden, Walnut Creek and two random fault lines have been identified in the area surrounding Westminster. According to the USGS, eastern Colorado is nearly aseismic.

Past Occurrences

The USGS has recorded numerous small earthquakes in the Denver metro area. The most powerful earthquake ever recorded in Colorado (1882), is estimated to have been about 6.6 on the Richter scale. (USGS). Colorado's most economically damaging earthquake occurred in the northeast Denver metro area in 1967. This earthquake cracked windows, pavement and wall plaster resulting in over \$1 million dollars in damage. Although the 1967 earthquake is believed to have been triggered by deep well injection activity, at least two published studies propose that the Rocky Mountain Arsenal fault could produce a 6.0 earthquake which would cause more than \$10 billion damage. (C. E. Council 2008)

The USGS reported 120 earthquakes in Colorado since the previous plan update (from March 29, 2017-March 29, 2022). The figure below displays the historic earthquake events in the state of Colorado, as identified in the Colorado Enhanced State Hazard Mitigation Plan 2018-2023. The closest earthquakes to the City of Westminster were recorded in Greeley on March 30th, 2019 (magnitude 2.9) and an earthquake located two km southeast of Georgetown, Colorado on October 24th, 2020 (magnitude 2.5). Neither of these events resulted in documented damages.

Figure 4-15 Earthquakes in Colorado



Source: Colorado Enhanced State Hazard Mitigation Plan 2018-2023

Geographical Area Affected

The Colorado Enhanced State Hazard Mitigation Plan 2018-2023 reported that many of Colorado’s earthquakes occurred in mountainous regions of the state; however, some have been in the western valleys and plateau region or east of the mountains. Thousands of faults have been mapped in Colorado, but scientists think only about 90 of these were active in the past 1.6 million years. The Golden Fault, located around 10 miles west of the City of Westminster, is the closest identified fault to the City. If there was an earthquake along this fault, the entire planning area would be impacted. Therefore, the area affected is rated as extensive for the City of Westminster.

Magnitude/Severity

Earthquake magnitude is typically expressed as a measurement of energy released as recorded on seismographs. The most severe earthquake magnitude generally occurs at the fault and decreases in severity with an increase in distance from the fault. Due to this, the severity of damage at one location can be significantly greater than the damage at another site from the same earthquake.

While there are several magnitude scales developed by seismologists, one of the first and most used scales is the Richter scale. The Richter Magnitude Scale is used to quantify the strength and magnitude of energy released during an earthquake. A summary of the scale and types of damages from this energy release can be found in the table below.

Table 4-11 Richter Magnitude Scale

Magnitude	Description	Typical maximum Modified Mercalli Intensity	Average earthquake effects	Average frequency of occurrence globally (estimated)
1.0–1.9	Micro	I	Microearthquakes, not felt, or felt rarely. Recorded by seismographs.	Continual/several million per year
2.0–2.9	Minor	I	Felt slightly by some people. No damage to buildings.	Over one million per year
3.0–3.9		II to III	Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.	Over 100,000 per year
4.0–4.9	Light	IV to V	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally, causes zero to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.	10,000 to 15,000 per year
5.0–5.9	Moderate	VI to VII	Can cause damage of varying severity to poorly constructed buildings. Zero to slight damage to all other buildings. Felt by everyone.	1,000 to 1,500 per year
6.0–6.9	Strong	VII to IX	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas, up to hundreds of kilometers from the epicenter. Strong to violent shaking in epicentral area.	100 to 150 per year
7.0–7.9	Major	VIII or higher	Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0–8.9	Great		Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions.	One per year
9.0 and greater			At or near total destruction – severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography.	One per 10 to 50 years

Source: US Geological Survey

Another method of measurement is the Modified Mercalli Intensity (MMI) Scale, which records the intensity of an earthquake event. This scale uses the felt or observed effects of earthquake shaking at a given location. The intensity of an earthquake is an expression of the amount of shaking and the resulting damages from that ground movement. The table below summarizes the Modified Mercalli Intensity (MMI) Scale. The greatest earthquake to occur near the City of Westminster in recent years occurred in 1967

near northeast Denver and was ranked as a magnitude 5.3 earthquake and VII intensity earthquake (2018 Colorado Enhanced State Hazard Mitigation Plan).

Table 4-12 Modified Mercalli Intensity (MMI) Scale

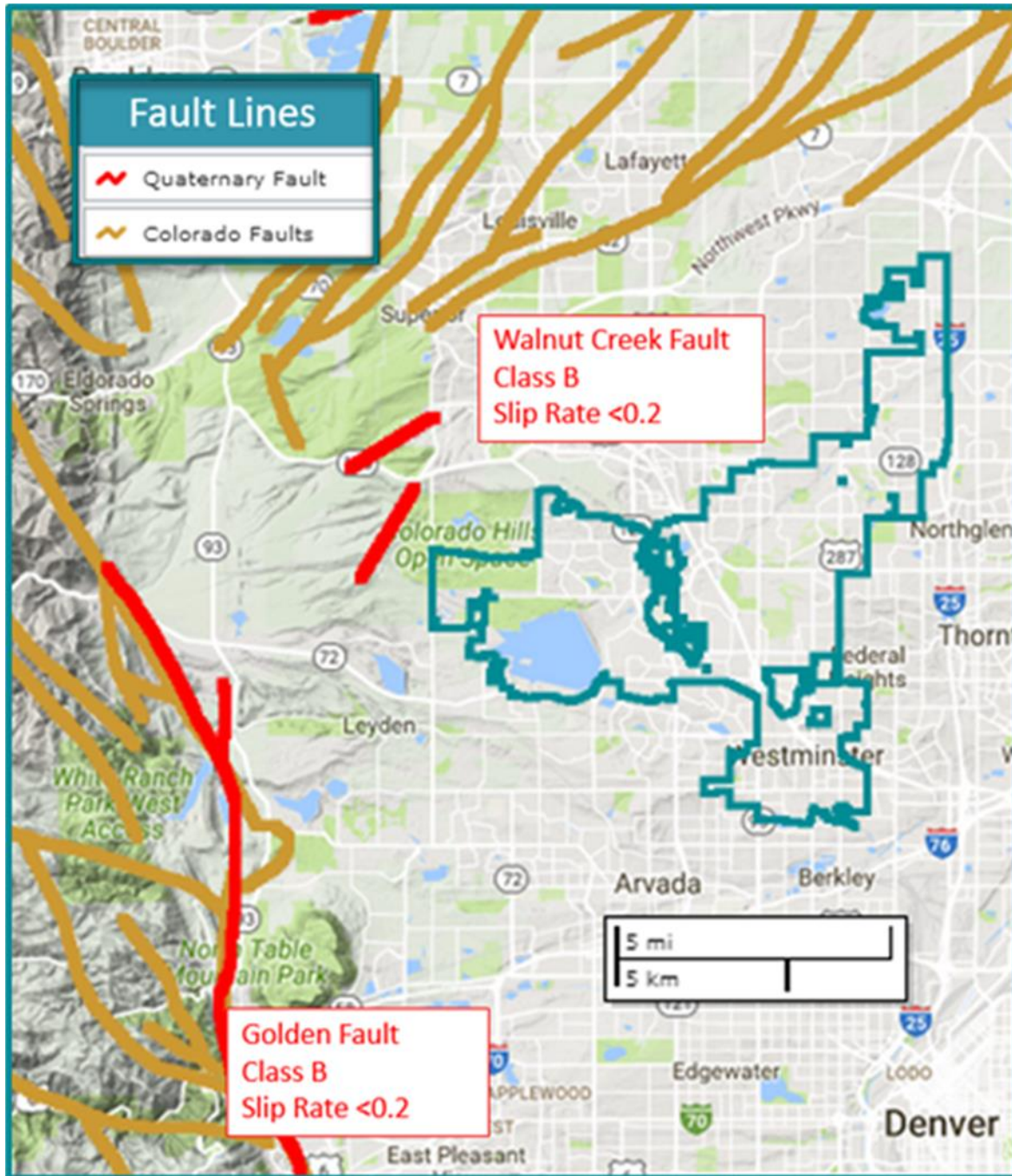
MMI Felt Intensity	MMI Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, and great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and

Source: Colorado Enhanced State Hazard Mitigation Plan 2018-2023

Frequency/Likelihood of Occurrence

The Colorado Enhanced State Hazard Mitigation Plan 2018-2023 reported that more than 500 earthquake tremors with a reported magnitude of 2.5 or higher have been reported in the state of Colorado since 1867. However, there have been very few severe earthquakes recorded in the State of Colorado in the past 150 years. While it is difficult to accurately determine the timing and location of future earthquake events in the City of Westminster, scientists use the location of seismic faults to predict where earthquakes could occur. The Golden Fault is the closest quaternary fault (a fault that has moved in the past 1.6 million years) to the City of Westminster. The figure below displays the location of faults in relation to the City of Westminster.

Figure 4-16 Fault Lines in Proximity of City of Westminster

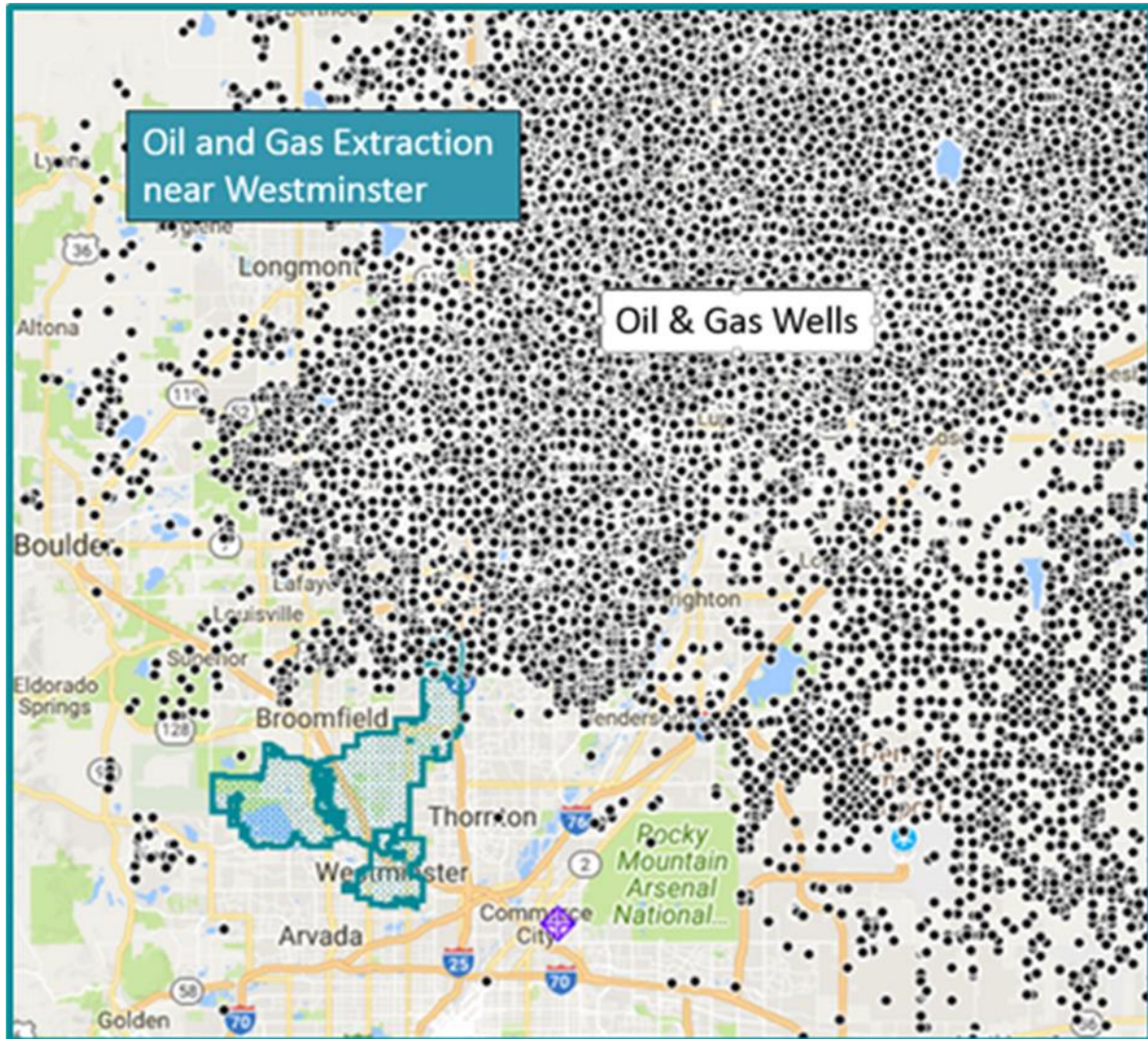


Source: The City of Westminster

Additionally, induced seismicity, or seismic events that are caused by human activity such as sequestering surface water reservoirs, fracking, and removing earth mass by quarrying could increase the frequency of future earthquake events. Although there are no active oil or gas wells within Westminster, the areas north and east of the city are very active and induced or triggered earthquakes are a continued topic of study. Due to Colorado's long history of induced earthquakes including a 5.3 event that struck the Trinidad area in August 2011, the Colorado Oil and Gas Conservation Commission (COGCC) asked the Colorado Geologic Survey (CSG) to review all new drilling permits for water disposal wells. The CGS has been

reviewing applications since 2011 and continues to work with the COGCC to understand this potential hazard. (Survey, Triggered (Induced) Earthquakes 2018)

Figure 4-17 Proximity of Oil and Gas Wells to City of Westminster



Source: City of Westminster

Climate Change Considerations

There is no direct link between climate change and earthquakes. However, human activity such as pumping of groundwater from aquifers located below earth's surface, which is exacerbated during periods of drought, has been shown to change patterns of stress loads of earth's crust which can result in minor, and generally unnoticeable, seismic activity. (NASA, 2019)

Vulnerability Assessment

Probabilistic Scenario

A 2,500-year probabilistic HAZUS earthquake scenario was performed as part of this mitigation plan's update to analyze the impacts to the counties of Adams and Jefferson, where the City of Westminster is located. The results can be referenced in the following table. This scenario considers worst case ground

shaking from a variety of seismic sources and analyzed data aggregated to both counties, which includes 32 census tracts in and around the City of Westminster. According to this probabilistic scenario, there is the potential for roughly 1,068 buildings experiencing at least moderate damage and \$208 million in economic losses, mostly associated with residential occupancies. Due to the low probability of a damaging earthquake occurring, as discussed below, the planning significance of earthquakes is considered low by the planning committee.

Table 4-13 Results of HAZUS Earthquake Scenario

Impact Category	Modeled Impacts	
Expected Buildings Damaged	Slight: 2,992 Moderate: 935 Extensive: 128 Complete: 5	
Total Economic Loss	\$208M	
Injuries	Without requiring hospitalization: 42 Requiring hospitalization: 7 Life Threatening: 0 Fatalities: 0	
Essential Facility Damage	None with at least moderate damage	
Transportation and Utility Lifeline Damage	None with at least moderate damage	
Households w/out Power & Water Service (Based upon 51,308 households)	Power loss @ Day 1: 0 Power loss @ Day 3: 0 Power loss @ Day 7: 0 Power loss @ Day 30: 0	Water loss @ Day 1: 0 Water loss @ Day 3: 0 Water loss @ Day 7: 0 Water loss @ Day 30: 0
Displaced Households	67	

Source: HAZUS

People

There are many potential impacts to the population from an earthquake and the cascading hazards which may follow. Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking.

Based on the HAZUS modeling, Westminster could withstand moderate damages from a large earthquake, but the probability of that occurring is small. Since Colorado does not experience many earthquakes, the public generally perceives that there is little risk, and therefore they are less likely to know what to do during an earthquake or how to prepare and protect themselves and their property from one. Scientists are unable to predict when the next major earthquake will happen in Colorado – only that one will occur. Due to the low probability the overall significance is considered low.

HAZUS estimates the number of people that will be injured and killed by the earthquake. HAZUS models potential casualty numbers based on magnitude and time of occurrence for the earthquake. Casualties are further broken out by occupancy class, and severity is separated into one of four categories.

Level 1: Injuries will require medical attention, but hospitalization not needed

Level 2: Injuries will require hospitalization, but are not considered life-threatening

Level 3: Injuries will require hospitalization and can become life-threatening if not promptly treated

Level 4: Victims are killed by the earthquake

HAZUS estimates are provided for three times of day: 2 a.m., 2 p.m., and 5 p.m. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2 a.m. estimate considers that the residential occupancy load is maximum, the 2 p.m. estimate considers

that the educational, commercial, and industrial sector loads are maximum, and 5 p.m. represents peak commute time. The following table shows casualty estimates for the different times of day.

Table 4-14 HAZUS 2500-year Probabilistic Scenario 5.00 Magnitude

		Level 1	Level 2	Level 3	Level 4
2 a.m.	Commercial	0.19	0.02	0.00	0.00
	Commuting	0.00	00.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.17	0.02	00.00	00.00
	Other- Residential	4.85	0.48	0.02	0.04
	Single Family	10.35	1.11	0.07	0.13
	Total	16	2	0	0
2 p.m.	Commercial	12.41	1.53	0.10	0.19
	Commuting	0.00	0.00	0.00	0.00
	Educational	8.55	1.03	0.06	0.12
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.22	0.14	0.01	0.01
	Other- Residential	1.29	0.13	0.01	0.01
	Single Family	2.76	0.31	0.02	0.04
	Total	26	3	0	0
5 p.m.	Commercial	8.96	1.12	0.08	0.14
	Commuting	0.00	0.00	0.00	0.00
	Educational	2.18	0.27	0.02	0.03
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.76	0.09	0.00	0.01
	Other- Residential	1.82	0.19	0.01	0.02
	Single Family	3.98	0.44	0.03	0.05
	Total	18	2	0	0

Source: HAZUS

Property

According to the HAZUS model, there are an estimated 50,000 buildings in the region with a total building replacement value (excluding contents) of \$23.7 billion. Approximately 93% of these buildings (and 73% of the building value) are associated with residential housing. In terms of building construction types found in the region, wood frame construction makes up 72.8% of the building inventory.

HAZUS estimates the number of buildings that will be damaged during a modeled earthquake, with these estimates provided in the tables below. The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.

The categories of damages defined by HAZUS are:

- Slight damage includes diagonal hairline fractures on most shear wall surfaces and hairline cracks on most infill walls.
- Moderate damage includes cracks on most walls and failure of some shear walls.
- Extensive damage means that most shear wall surfaces in the structure have reached or exceeded their capacity exhibited by large, through-the-wall diagonal cracks.
- Complete damage means that the structure has collapsed or is in danger of collapse.

For each earthquake, most structures will either not be damaged or suffer slight damage. According to the 2,500-year 5.0 M model, an estimated 1,068 buildings in the planning area will at least be moderately damaged. This is over 2% of all buildings in the region.

Table 4-15 Expected Building Damage by Occupancy – 2,500-year 5.0 M Earthquake

	None	%	Slight	%	Moderate	%	Extensive	%	Complete	%
Agriculture	54.2	0.1	4.3	0.1	2.1	0.2	0.4	0.3	0.0	0.2
Commercial	2,211.1	4.8	208.5	7.0	103.0	11.0	18.8	14.6	0.7	14.6
Education	97.2	0.2	7.6	0.3	3.6	0.4	0.6	0.4	0.0	0.4
Government	48.1	0.1	3.3	0.1	1.4	0.2	0.2	0.1	0.0	0.1
Industrial	508.9	1.1	49.1	1.6	26.8	2.9	5.1	4.0	0.1	2.2
Other Residential	6,756.3	14.6	501.6	16.8	167.7	17.9	17.9	13.9	0.6	11.5
Religion	101.4	0.2	7.6	0.3	3.4	0.4	0.5	0.4	0.0	0.4
Single Family	36,488.7	78.9	2209.6	73.9	627.3	67.1	85.0	66.2	3.4	70.7
Total	46,266		2,992		935		128		5	

Source: HAZUS

Critical Facilities

Based on the HAZUS model, the greatest amount of damage to critical facilities would occur to schools in the planning area. The HAZUS model identified 2 hospitals in the planning area with over 100 beds, 55 schools, 11 fire stations, 2 police stations, and 2 emergency operations facilities. However, the model showed that all critical facilities would have functionality on the day of the earthquake, so damages would be minimal. There are no high loss potential facilities such as dams, hazardous materials sites, nuclear power plants, or military installations in the region.

Regarding transportation and utility service lines, the model identified the total value of the transportation and utility lifeline inventory to be over \$4.09 billion dollars, which includes 163.4 miles of highways, 79 bridges, and 1,173 miles of pipes. The model predicted minimal damages to utility systems, with no facilities experiencing “complete damage” and all remaining at least 50% functional on the day of the earthquake. No households are expected to lose potable water or electric power services due to the earthquake. HAZUS also estimated that potable water systems would experience four leaks and one break during an earthquake event.

Economy

Based on the HAZUS run there could potentially be \$208 million in economic losses, mostly associated with residential occupancies (53%). In general, impacts would be related to debris cleanup and management, building and infrastructure damage, and losses related to business and infrastructure interruption.

Building losses are broken into two categories – direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake. The following table breaks down these projected economic losses for each earthquake scenario by building type. In total, the model estimates \$203.6 million in economic losses between income and capital stock losses in the planning area.

Table 4-16 Economic Losses – 2,500-year Probabilistic Earthquake Scenario (Millions of Dollars)

Category	2,500-year 5.0 M Earthquake					Total
	Single Family	Other Residential	Commercial	Industrial	Others	
Income Losses (Millions of Dollars)	7.1	5.2	20.5	0.9	5.6	39.3

2,500-year 5.0 M Earthquake						
Capital Stock Losses (Millions of Dollars)	69.3	27.3	40.1	8.8	18.8	164.3
Total	76.4	32.5	60.6	9.7	24.4	203.6

Source: HAZUS

Historical, Environmental, Cultural Resources

Typically, historic buildings not built to code are more vulnerable to seismic activity that could result in structural damages. The National Register of Historic Places lists several historic properties located in the planning area. An earthquake in the city could potentially damage these historic structures with cultural significance to the area. See Section 4.1.4 for a list of historic sites in the City of Westminster.

Development Trends

Any new construction built to modern codes and construction standards in Westminster should generally be able to withstand earthquakes. It will be important that buildings are securely attached to their foundations to avoid potential shifting.

4.3.4 Epidemic/Pandemic

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Epidemic/Pandemic	C	5	5	5	C5

Hazard/Problem Description

An epidemic is an increase (often sudden) in the number of cases of a disease above what is normally expected in the population of an area. A pandemic is an epidemic that has spread over several countries or continents, usually affecting a large number of people. (Control 2012)

Microorganisms (bacterial, viruses, parasites, fungi, etc.) are ubiquitous in the environment. These organisms are a vital part of the ecosystem and are generally harmless or helpful for society. Pathogenic microorganisms are microorganisms that can cause diseases that may become infectious and spread among the population. Over a quarter of deaths worldwide are the result of infectious disease. The spread of infectious diseases happens through direct contact with an infected individual and their bodily fluids, through indirect contact with objects or surfaces that have been contaminated by an infected individual, as well as through vector-borne pathogens that transmit infections through an intermediary such as plants, fungi, and various breeds of bloodsucking insects. Zoonotic diseases are diseases found in animals and may be transmitted to humans. Some, but not all, zoonotic diseases may also be transmitted from person-to-person.

Pandemic diseases are among the most dangerous hazards facing human civilization. The danger posed by diseases varies depending on the means and rate of transmission, the associated mortality/morbidity rates, the availability of prophylaxis and the availability of effective treatment. The most dangerous infectious diseases are airborne diseases that spread quickly with person-to-person contact. These are more common in colder months with populations clustered together indoors. Sanitation and hygiene are also major factors in the transmission and risk posed by these diseases.

Influenza: Influenza occurs yearly in seasonal form and periodically in epidemic or pandemic form. Seasonal influenza is a common occurrence and there is a good degree of immunity from previous outbreaks in communities to mitigate damages, generally 70-90% of seasonal influenza fatalities are in populations age 65 and older. The actual number of cases and fatalities in the adult population from flu on a yearly basis is difficult to gauge as states are not required to report individual flu cases and influenza is infrequently listed on death certificates of those who die from flu-related complications. Epidemic or pandemic influenza varies in severity, but populations may not have any immunity to these strains. Novel strains can easily create shortages in vaccines and antivirals and overwhelm public health resources.

Additionally, lost productivity caused by the virus, as well as mitigation efforts, can have major repercussions on transportation, critical infrastructure, economic activity, and social activities of all kinds. Flu strains mutate and transition between animals and humans. Dogs, cats, and bats can carry flu, but the greatest risk comes from poultry and swine involved in industrial farming. These industries can also serve as an incubator for diseases to become immune to antivirals and virtually impossible to combat.

Escherichia coli (E. coli): E. coli is a diverse group of bacteria. While most strains are harmless, many disease-carrying strains produce toxins called Shiga toxins. The primary source of these diseases are livestock and poor sanitation. Approximately, 8% of those infected, and up to 20% of children, will develop potentially life-threatening complications from E. coli.

Pertussis: Bordetella pertussis or whooping cough is found in humans and normally spreads through person-to-person contact with sneezing or coughing. This disease causes violent fits of coughing, but normally only children will develop fatal complications. This disease is largely managed through vaccinations. Fully vaccinated persons are still at risk of catching the disease, although usually in a less severe form. Pertussis is treated with antibiotics.

Salmonellosis: Salmonellosis is caused by bacteria called Salmonella and is dangerous to the elderly, infants, and those with compromised immune systems. Salmonellosis is spread by eating raw or undercooked food that is contaminated with Salmonella. The disease is further spread by infected individuals who practice poor hygiene as well as animals, specifically lizards.

Coronaviruses: Coronaviruses were first discovered in the mid-1960s. There are many of these viruses that infect animals and there are, currently, seven discovered strains that infect people, listed in the table below.

Table 4-17 Human Coronavirus Strains

Human coronavirus name	Illness
SARS-CoV-2	COVID-19
SARS-CoV	Severe acute respiratory syndrome (SARS)
MERS-CoV	Middle East respiratory syndrome (MERS)
HCoV-NL63	Mild respiratory illness
HCoV-229E	
HCoV-OC43	
HKU1	

Source: UK Research and Innovation

Transmission of coronaviruses generally occurs through coughing/sneezing and personal contact person-to-person. Coronaviruses are common worldwide, with the exceptions of the beta coronaviruses SARS-CoV (the virus that causes Severe Acute Respiratory Syndrome – SARS) and MERS-CoV (the virus that causes Middle East Respiratory Syndrome – MERS). SARS-CoV first emerged in China in November of 2002 and caused a worldwide outbreak with 8,098 probable cases (27 in the US) and 774 deaths from 2002-03. There have been no known cases of SARS since 2004. MERS-CoV first emerged in Saudi Arabia in 2012 and has spread throughout the Middle East, Southeast Asia, and Europe. Most cases and fatalities have occurred in Saudi Arabia and the United Arab Emirates. COVID-19 was first reported in December 2019, in Wuhan China, and became the largest global pandemic in history after deaths surpassed the 1918 flu pandemic’s death toll. As of May 3rd, 2023, 765.2 million confirmed cases of COVID-19 and 6.9 million deaths globally were reported to the World Health Organization. Of these, over 103.2 million confirmed cases and 1.1 million deaths occurred in the United States. There are no specific treatments for illnesses caused by human coronaviruses, but 13.3 billion COVID-19 vaccine doses have been administered across the globe.

Past Occurrences

1918 – H1N1 Spanish Flu: This was the most severe pandemic in recent history until the 2020 COVID-19 pandemic. There were three waves between 1918-19. Mortality was high in populations under 5, 20-40 years old, and 65 years and older. The high mortality among healthy people in the 20-40 years age range was a unique characteristic of this pandemic. Control efforts were limited to non-pharmaceutical interventions such as isolation, quarantine, personal hygiene, the use of disinfectants and limitations of public gatherings. The worldwide death rate was between 1-3% of the global population. Between September 1918 and April 1919, 500,000 Americans died.

1952 – Polio Epidemic: The United States had a major polio epidemic in 1916, but outbreaks in the 40s and 50s created chaos and quarantine conditions across the nation. The epidemic peaked in 1952 with over 58,000 infected and 3,145 deaths. Vaccination efforts lead to polio being eradicated in the United States in 1979.

1957 – H2N2: This virus was quickly identified due to advances in technology, and a vaccine was produced. Globally, more than 500 million people were infected and an estimated 1 to 4 million people lost their lives. Infection rates were highest among school children, young adults, and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In total, there were about 70,000 deaths in the United States.

1968 – H3N2: “Swine Flu” arrived in the United States in 1968 and the majority of the 100,000 US fatalities were in the 65-years and older age range. The 1968 strain has transitioned to a seasonal flu and still circulates the globe. CDC estimates the 1968 flu pandemic had a global mortality of .03%.

1993 – Cryptosporidium Outbreak in Milwaukee: One of two water treatment plants in Milwaukee became contaminated with cryptosporidium, resulting in the largest waterborne outbreak in US history, with 403,000 becoming ill and 100 deaths.

2009 – H1N1: This novel flu was first detected in the United States and contains a unique combination of influenza genes not previously identified in animals or people. Nearly one-third of people over the age of 60 had antibodies against this virus, likely from an exposure to an older H1N1 virus. According to CDC estimates, 80% of fatalities for the 2009 flu were people younger than 65. This strain continues to circulate globally as a seasonal flu. The worldwide death rate for the 2009 outbreak was estimated to be between 151,700 and 575,400 for the year.

2010 – Whooping Cough Outbreak in California: Outbreaks of pertussis, particularly among teens and children have increased since the 1980s. The 2010 outbreak in California led to 9,477 cases with 10 infant deaths.

1980s to Present – AIDS Epidemic: Acquired Immune Deficiency (AIDS) is the final stage of an illness caused by a Human Immunodeficiency Virus (HIV). This disease is spread through fluids, such as through blood transfusions, the sharing of needles, sexual contact or from an infected pregnant woman to her child. AIDS has spread in the United States for almost 40 years and, while treatments have improved the chances for survival, is a leading cause of death worldwide and the sixth leading cause of death in the United States.

2020-Ongoing – COVID-19: The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March 2020. As of March 2023, 761.0 million cases have been reported around the world with over 6.8 million deaths. In the United States, over 102.5 million cases have been reported with over 1.1 million deaths in the United States. As of March 2023, Jefferson County has reported 161,298 confirmed cases and 1,560 deaths and Adams County has reported 166,901 cases and 1,469 deaths. Based on local county health department reports, Westminster experienced 32,955 confirmed cases of COVID-19 and 270 deaths due to COVID-19. The pandemic is expected to persist into the foreseeable future, as the virus continues to mutate into different variants.

Emerging Diseases

Emerging diseases are those whose incidence in humans has increased in the past two decades or threatens to increase in the near future. Two-thirds of new diseases are zoonotic, and mutation along with poor practices in agriculture can lead to antimicrobial-resistant disease that can only be combated with non-pharmaceutical methods. A re-emergence of old diseases with genetic variations or because of a decreased compliance with vaccination policy has become common in recent decades, and the global economy has created new avenues for infectious diseases to spread. For example, international travel or trade in exotic and esoteric plants and animals create novel situations of transmission. Effective surveillance and reporting along with the speed of notification is essential when combating outbreaks.

Table 4-18 Colorado Reportable Disease Data – June 2019 (most recent data)

Significant Diagnosis (50+ cases)	Cases in Adams Co.	Cases in Jefferson Co.
Animal Bites	193	315
Campylobacteriosis	80	112
Carbapenem-Resistant Pseudomonas Aeruginosa (CRPA)	94	95
Group A Strep Invasive	69	73
Hepatitis B, Chronic	57	41
Hepatitis C, Chronic	325	385
Influenza – Hospitalized	418	453
Pertussis	54	118
Salmonellosis	44	61
Strep Pneumo Invasive	52	47
Total	1,673*	1,959*

Source: Colorado Department of Public Health and Environment

Bubonic Plague and West Nile Encephalitis are examples of zoonotic diseases that have become endemic in Colorado after their introduction. Plague is believed to have entered the US via west coast ports in 1911 and transmitted to our rodent population (especially prairie dogs in our area) where outbreaks can pose a threat to pets and people who visit open spaces. West Nile Virus was first noted in New York in 1999 and became endemic in Colorado in 2002.

Geographical Area Affected

The entirety of the City of Westminster could potentially be affected by a pandemic flu outbreak or epidemic disease.

Magnitude/Severity

Overall, the impacts of a pandemic flu outbreak in the City of Westminster could be critical, with a significant percentage of the planning area's population affected. Local medical facilities could be rapidly overwhelmed. In a severe pandemic or epidemic case, the medical facilities of neighboring jurisdictions would most likely be overwhelmed as well and unable to provide assistance to the City of Westminster.

Frequency/Likelihood of Occurrence

Although it is impossible to predict the next disease outbreak, there is recent history that shows these outbreaks are not uncommon and are likely to reoccur. Based on the five pandemics that have affected the United States in roughly the last 100 years, a pandemic occurs on average roughly every 20 years. In other words, there is a 5% probability that a pandemic that affects the entire United States will occur in any given year.

For the current COVID-19 pandemic, due to the virus's ability to mutate and rapidly infect those who are not vaccinated, the pandemic may extend for several years, and booster vaccines may be necessary to prevent future outbreaks. In just the last couple of decades, the world has drastically increased points of transmission through global travel and trade to levels unseen in human history – this may have a drastic impact on the frequency of pandemics and the speed with which they spread in coming years.

Climate Change Considerations

According to the CDC and EPA, climate change is expected to affect the geographic and seasonal patterns of vector-borne diseases transmitted by mosquitoes, ticks, fleas, or other arthropods. For example, West Nile virus was first detected in the United States in 1999 and is now the most common cause of mosquito-borne disease in the United States in most years. Between 1999 and 2019, 51,801 cases of West Nile were reported to the CDC, nearly half of them affecting the brain or causing neurologic dysfunction. West Nile was first detected in Colorado in 2002. CDPHE documented 122 cases and 8 West Nile virus associated deaths in 2019.

As the earth's climate continues to warm, researchers predict wild animals will be forced to relocate their habitats — likely to regions with large human populations — dramatically increasing the risk of a viral jump to humans that could lead to the next pandemic. This link between climate change and viral transmission is described by an international research team led by scientists at Georgetown University and was published on April 28, 2022, in *Nature*. The scholars noted that the geographic range shifts due to climate change could cause species that carry viruses to encounter other mammals to share thousands of viruses. The viruses can then further be spread to humans. In addition, rising temperatures caused by climate change will impact bats, which account for the majority of novel viral sharing. Bats' ability to fly will allow them to travel long distances and share the most viruses. Altogether, the study suggests that climate change will become the biggest upstream risk factor for disease emergence — exceeding higher-profile issues like deforestation, wildlife trade and industrial agriculture. The authors say the solution is to pair wildlife disease surveillance with real-time studies of environmental change ("New Study Finds Climate Change Could Spark the Next Pandemic – Georgetown University Medical Center" 2022).

Vulnerability Assessment

Historically, epidemics/pandemics have been the single greatest natural cause of death. While improvements in public health and medicine have greatly reduced this hazard, we have the potential to become victims of our own success. Emerging and re-emerging and newly resistant diseases that can be rapidly spread through high-speed global transportation and supply chains pose a persistent challenge to our public health and medical response communities. Climate is a major factor in affecting diseases and their transmission. A warmer climate may expand the geographic ranges of insects, snails and cold-blooded animals that spread diseases. Transmission seasons may also be extended. (Organization 2018)

People

Pandemics can affect large segments of the population for long periods of time. According to the 2018 Colorado State Hazard Mitigation Plan, a pandemic flu outbreak could affect approximately 30% of the state's overall population, with as much as 10% possibly needing hospitalization. The number of hospitalizations and deaths will depend on the virulence of the virus. Risk groups cannot be predicted with certainty; the elderly, people with underlying medical conditions, and young children are usually at higher risk, but as discussed above this is not always true for all influenza strains. People without health coverage or access to good medical care are also likely to be more adversely affected. Compared to other counties in Colorado, Adams County's social vulnerability index is high, but Jefferson County's social vulnerability index is low. However, one of the long-term effects of a pandemic that lasts several years, as demonstrated by COVID-19, is mental health.

Property

Property itself is unlikely to be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Additionally, in a pandemic situation traditional congregate sheltering facilities, such as homeless shelters or temporary evacuation centers or camps, would not be possible due to the

close quarters these facilities create. Working around this issue would require additional planning considerations or the use of facilities that allow for non-congregate shelter settings. These may require approval of a request to FEMA for non-congregate sheltering and may have an increased cost, such as the use of individual hotel rooms, as opposed to traditional congregate sheltering facilities.

Critical Facilities

Hospitals and morgues will be heavily affected and may be overwhelmed. Other critical facilities and infrastructure are not directly affected by a pandemic but may have difficulty maintaining operations and maintenance activities due to a significantly decreased workforce. Schools may be forced to close. Government facilities may have difficulty continuing to provide services due to staffing shortages.

Economy

In a normal year, lost productivity due to illness costs US employers an estimated \$530 billion. During a pandemic, that figure would likely be considerably higher and could trigger a recession or even a depression. Mandatory shutdowns of businesses and services in the early weeks of the COVID-19 pandemic, for example, resulted in over 22 million people without jobs. The National Association of Counties reported that the COVID-19 pandemic had the potential to impact county budgets by over \$144 billion in the 2021 fiscal year alone. Stay at home orders during the COVID-19 pandemic resulted in significant losses in sales taxes, which many counties rely on for a significant portion of their revenue.

The number of workdays lost due to disease for both self-care and care of sick family members can create a significant impact to the local economy in the City of Westminster. Moreover, additional workdays could be lost due to secondary impacts such as social distancing and the closure of schools and businesses.

Historical, Environmental, Cultural Resources

Impacts on these resources are typically minimal. However, reduced tourism could lead to additional economic impacts. Additionally, long lasting pandemics such as COVID-19 could impact aspects of culture, such as how populations work, go to school, and view entertainment.

Development Trends

Population growth and development contribute to pandemic exposure. Future development in and around the City of Westminster has the potential to change how infectious diseases spread through the community and impact human health in both the short and long-term. New development may increase the number of people and facilities exposed to public health hazards and greater population concentrations (often found in special needs facilities and businesses) put more people at risk. During a disease outbreak, those in the immediate isolation area would have little to no warning, whereas the population further away in the dispersion path may have some time to prepare and mitigate against disease depending on the hazard, its transmission, and public notification.

4.3.5 Erosion, Deposition and Turbidity

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Erosion, Deposition and Turbidity	B	1	2	3	B3

Hazard/Problem Description

Erosion, deposition, and turbidity is a complex hazard that is closely related to the quality of our watersheds and the forests that are the basis of our water supply. Recent wildfires in Colorado have demonstrated the negative effect deforestation can have on a natural watershed’s ability to prevent erosion. Intense events such as the 2002 Hayman Fire can damage soil and greatly slow the recovery of the vegetation or permanently degrade the biome. Invasive species (primarily the pine bark beetle) are also endangering the health of our forests and the watersheds that supply the Front Range. A healthy

forest provides natural filtration and slows the runoff of snowmelt and rain. (Lukas 2014) A significant forest fire in the watersheds that supply Westminster, and the Front Range communities could lead to deposition in our streams, ditches and reservoirs as well as a general degradation of raw water quality. One of Colorado's largest wildfires, the Hayman Fire in 2002, burned 229 square miles and came within 30 miles of Westminster's primary water source, the Clear Creek watershed. The 2011 Indian Gulch fire (10.9 square miles) has been the largest fire in the Clear Creek watershed to date, but wildfire is a persistent danger that is exacerbated by drought and invasive species. Although the Clear Creek watershed is outside the boundaries of the city, any event affecting the environmental quality and sustainability of this critical natural resource is of great concern to Westminster.

Past Occurrences

While there is not a database available that specifically lists instances of erosion and deposition in the City of Westminster, the 2018 Colorado State Hazard Mitigation notes that erosion is often caused by weather-related events such as heavy rainfall, wind, snow, and ice. The City of Westminster hazard mitigation planning team noted major rain events in 2013 and 2015, which damaged the ditches supplying the City's raw water, deposited sediments in the water supply, and increased turbidity in area water supplies. Additionally, flood and wildfire can remove the vegetation that holds soil in place, resulting in significant erosion. See Section 4.3.9 for information on past flood events in the City of Westminster and 4.3.16 for information on past wildfire events.

Geographical Area Affected

Erosion and deposition can impact all waterways and lakes in the planning area; therefore, the hazard extent is significant. Water quality of the Clear Creek watershed is closely monitored and procedures are in place to close the intakes to the ditches used to supply Standley Lake. However, a severe precipitation event over the Big Dry Creek watershed could result in erosion and deposition affecting ditches, streambeds, reservoirs, open space, and stormwater management structures. Heavy sediments can settle out in the water infrastructure limiting its capacity or clogging it. Lighter sediments can remain suspended in the water supply for an extended period degrading water quality and resulting in increased treatment costs.

Magnitude/Severity

The impacts of erosion, deposition, and turbidity can be critical. When soil is removed by wind, snow, ice, and rain, and deposited into water systems, the soil can carry harmful chemicals such as pesticides, herbicides, and fertilizers that can contaminate the water supply. This can result in deteriorated water quality, loss of safe community drinking water, and creation of algae blooms which threatens the life of aquatic plants and animals. Additionally, the EPA reported that increased sediment in lakes can affect storage capacity of reservoirs, reducing quantity and quality of drinking water sources. Turbidity is a measure of water clarity. High turbidity makes water appear cloudy or muddy. Turbidity and total suspended solids (TSS) are different ways to measure similar water quality characteristics. Turbidity is measured in nephelometric turbidity units (NTU). Turbidity values less than 10 NTU are considered low, a value of 50 NTU would be considered moderately turbid, and very high turbidity values can be more than 100 NTU. Turbidity levels of 50 and above could be experienced in the water bodies in Westminster, and be exacerbated by drought and wildfire hazards.

Frequency/Likelihood of Occurrence

While it is difficult to predict the future likelihood of erosion, deposition, and turbidity, the most significant periods of erosion are likely to occur in conjunction with other hazard events, such as after a flood or wildfire event, or during periods of heavy rain, high wind, and ice storms. Additionally, invasive species that damage natural vegetation can result in increased erosion of soils.

Climate Change Considerations

The USDA reported that climate is a major driver of erosion. Observed trends related to climate change (e.g., shorter winter, less snowpack, earlier thaw/runoff, and more extreme weather events) are changing the dynamics of our water supply, its quality, quantity and human uses. Any changes in climate, such as a

shift in precipitation patterns that increase the intensity of rain events, can increase erosion and deposition of sediment in rivers, streams, and lakes. Higher rivers with faster stream velocity due to greater intensity and frequency of storms can increase the turbidity of water systems and negatively impact the ecosystem.

Vulnerability Summary

People

All people who depend on freshwater resources can be impacted by erosion, deposition, and turbidity. Erosion of soils that contain chemicals such as herbicides and pesticides can contaminate the local fresh water supply. Additionally, an increase in sediment in the Standley Lake reservoir could reduce the storage of freshwater accessible to the community. Outdoor enthusiasts, such as those who use Standley Lake, could experience negative impacts of erosion if excess nutrients from the soil runoff into the lake and cause an algae bloom, which can threaten aquatic life.

Property

Erosion has the potential to cause structural damage in property by undermining the foundational support of the buildings. Additionally, structures located on slopes could collapse during periods of heavy rainfall when soil is removed and deposited elsewhere. Water containing sediment that enters drainage systems could also cause blockages that perpetuate flooding.

Critical Facilities

Similar to property, critical facilities could be vulnerable to structural damage due to erosion. Drainage systems that the community uses to redirect water away from essential property are at risk to blockages due to water containing sediment. Sediment on roadways can also make these streets hazardous to drivers and cyclists when wet.

Economy

Erosion can decrease the recreational value of a body of water, such as Standley Lake. Additionally, it can be costly for drinking water treatment plants to filter out sediment in the water caused by erosion.

Historical, Environmental, Cultural Resources

Erosion can have significant impacts on environmental resources. Excessive nutrients deposited from soils in waterways can create algae blooms, which smothers breeding ground for aquatic plants and wildlife. Additionally, sediment in the water can cause damage to fish gills, further reducing the viability of life in these waterways. Erosion and deposition can also alter the natural flow of rivers and streams, impacting the ecology in the area.

Development Trends

Poor construction practices can perpetuate erosion and sediment in local waterways. When construction sites are not managed properly, soil and other sediment can be washed away during periods of rain and wind. Additionally, development that results in the reduction of vegetation can increase erosion. Natural vegetation creates soil stability, and increasing urban development can reduce the number of plants with roots that typically keep the dirt in place.

4.3.6 Swelling Soils

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Expansive Soils	E	1	3	2	E3

Hazard/Problem Description

Soils and swelling bedrock contain clay which causes the material to increase in volume when exposed to moisture and shrink as it dries. They are also commonly known as expansive, shrinking and swelling,

bentonitic, heaving, or unstable soils and bedrock. The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall.

The amount of swelling (or potential volume of expansion) is linked to five main factors: the type of mineral content, the concentration of swelling clay, the density of the materials, moisture changes in the environment, and the restraining pressure exerted by materials on top of the swelling soil. Each of these factors impact how much swelling a particular area will experience, but may be modified, for better or worse, by development actions in the area.

- **Low:** This soils class includes sands and silts with relatively low amounts of clay minerals. Sandy clays may also have low expansion potential if the clay is kaolinite. Kaolinite is a common clay mineral.
- **Moderate:** This class includes silty clay and clay textured soils, if the clay is kaolinite, and includes heavy silts, light sandy clays, and silty clays with mixed clay minerals.
- **High:** This class includes clays and clay with mixed montmorillonite, a clay mineral which expands and contracts more than kaolinite.

Swelling soils cause more property damage than any other geological hazard in Colorado. Swelling soils are found throughout Colorado, including in the City of Westminster. Swelling soils may expand up to 20% and exert up to 30,000 pounds of force per square foot when wet. They damage foundations, driveways, walkways, roads, pipelines, and sewers. (Colorado Geological Survey-Swelling Soils 2017) However, because the hazard develops gradually and seldom presents a threat to life, expansive soils have received limited attention, despite their costly effects. Expansive soils can also contribute to or cause damage to roadways, bridges, pipelines, and other infrastructure.

Past Occurrences

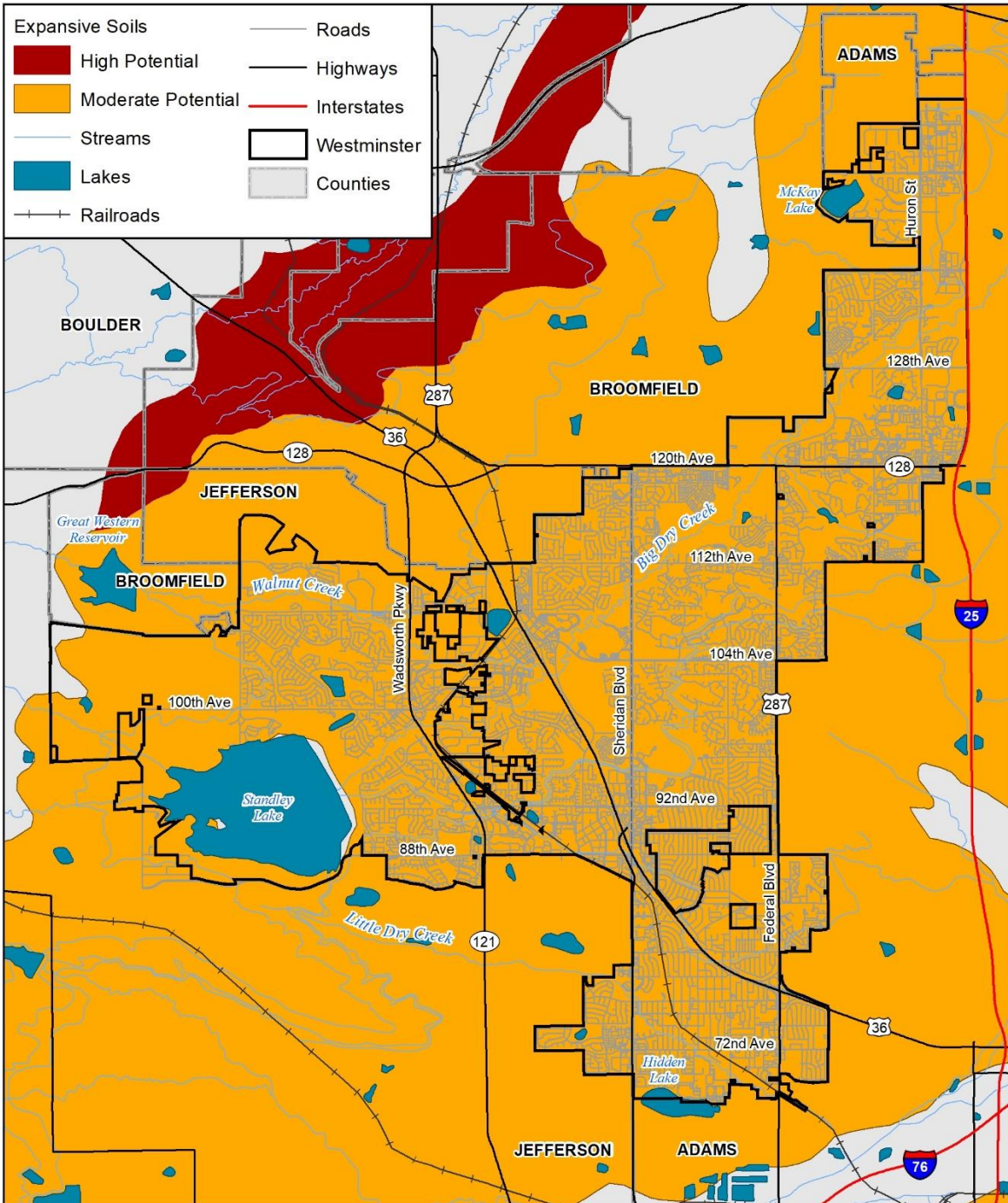
There have been no recorded incidences of disaster associated specifically to expansive soils in the City of Westminster. This is likely due to expansive soil damages going unreported and because no database exists to catalog occurrences, not because of a lack of events occurring in the planning area.

Geographical Area Affected

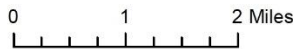
According to the Colorado Enhanced State Hazard Mitigation Plan 2018-2023, expansive soils occur throughout Colorado, although the shrink-swell potential varies by area. The State Plan evaluated the potential for shrinking and swelling soils.

The figure below displays a map of swelling soils in the City of Westminster. The City of Westminster is in an area of moderate potential for swelling soils.

Figure 4-18 City of Westminster Expansive/Swelling Soils



Map compiled 11/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
Colorado Geological Survey



Magnitude/Severity

The higher the potential for swelling soils, the greater the possible damage to infrastructure and homes constructed on those soils. Swelling soils may expand up to 20% and exert up to 30,000 pounds of force per square foot when wet. As previously described in the Hazard/Problem Description the amount of swelling (or potential volume of expansion) is linked to five main factors: the type of mineral content, the concentration of swelling clay, the density of the materials, moisture changes in the environment, and the restraining pressure exerted by materials on top of the swelling soil. They damage foundations, driveways, walkways, roads, pipelines, and sewers. As shown in the previous map The City of Westminster is in an area of moderate potential for swelling soils. Damages due to expansive soils such as foundation cracks, parking lot/sidewalk cracks, etc. may occur but are generally handled by individual property owners and insurance.

Frequency/Likelihood of Occurrence

Since records of specific occurrences are not readily available, it is difficult to estimate the probability of future occurrences. However, the USGS reports that expansive soils are likely to impact areas throughout the State of Colorado in the future, although these events may go unreported or undocumented. Most of the damages that occur due to expansive soils include cracks and breaks in existing infrastructure, particularly infrastructure composed of rigid materials such as cement.

Climate Change Considerations

Many soils and rocks have the potential to swell or expand based on a combination of their mineralogy and water content. The actual swelling of expansive soils will be caused by a change in the environment (e.g., water content, stress, chemistry, or temperature) in which the material exists. Changes in humidity and precipitation in Colorado, which are anticipated with a changing climate, could therefore impact the severity of swelling soils in the City of Westminster. More extremes in climate conditions (e.g., wet-dry conditions), could potentially exacerbate the swelling of expansive soil issues in the future.

Vulnerability Summary

It has been estimated that 1 out of 3 houses in the Front Range is built on swelling soil. Repairs to damaged foundations typically cost \$30,000 to \$70,000. There is no special insurance or federal emergency funds to address damages caused by swelling soil. (David C. Noe 2014) The nature of these soils in conjunction with our cycles of drought and moisture (possibly exacerbated by climate change) poses an ongoing probability of significant property damage/loss. Residents who are new to Colorado may not be familiar with this hazard, their rights under Colorado Senate Bill 13 (1984), C.R.S. 6-65-101 and their role as responsible property owners in mitigating this hazard.

People

The American Society of Civil Engineers estimated that as high as a quarter of the homes in the United States have some level of damage due to expansive soils. While in most cases the damage from expansive soils is minimal and can be remediated if caught early enough, extreme cases of expansive soils can result in total foundation failure of a home and pose risk to any occupants living inside the home.

Property

Older construction may not be resistant to swelling soil conditions and, therefore, may experience expensive and potentially extensive damages. This includes heaving sidewalks, structural damage to walls and basements, the need to replace windows and doors, or dangers and damages caused by ruptured pipelines.

Critical Facilities

Existing critical facilities impacted by expansive soil hazards are of particular concern, as the damages caused to these structures may impact the ability of the planning area to provide critical services to the population. Additionally, rigid utility pipelines are vulnerable to structural damage from expansive soils.

Economy

The American Society of Civil Engineers (ASCE) reported the annual cost of damages from expansive soils in the United States is \$2.3 billion. Road closures or detours during expansive soil repairs can result in temporary economic impacts. Most homeowner insurance policies do not cover expansive soils, which could create financial burden for local homeowners who experience home damages.

Historical, Environmental, Cultural Resources

Expansive soils are a natural environmental process. Nonetheless, they have the potential to alter the landscape and can cause damages to historic and cultural resources. Similar to all other property, any historic or culturally significant building that was constructed on soils with high swelling potential are vulnerable to structural damages from these soils.

Development Trends

The most effective mitigation actions for expansive soil are complete avoidance or non-conflicting use, or correct engineering design. Modern building practices incorporate mitigation techniques, such as foundation design, adequate drainage, landscaping, and appropriate interior finishing, provided proper geotechnical testing is employed to identify expansive soils. If areas prone to expansive soils are identified, future areas for development will need to take this hazard into account. Due to mitigation with new development and generally low rates of development, losses are not expected to increase with this hazard.

4.3.7 Extreme Cold

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Extreme Cold	D	5	3	3	D4

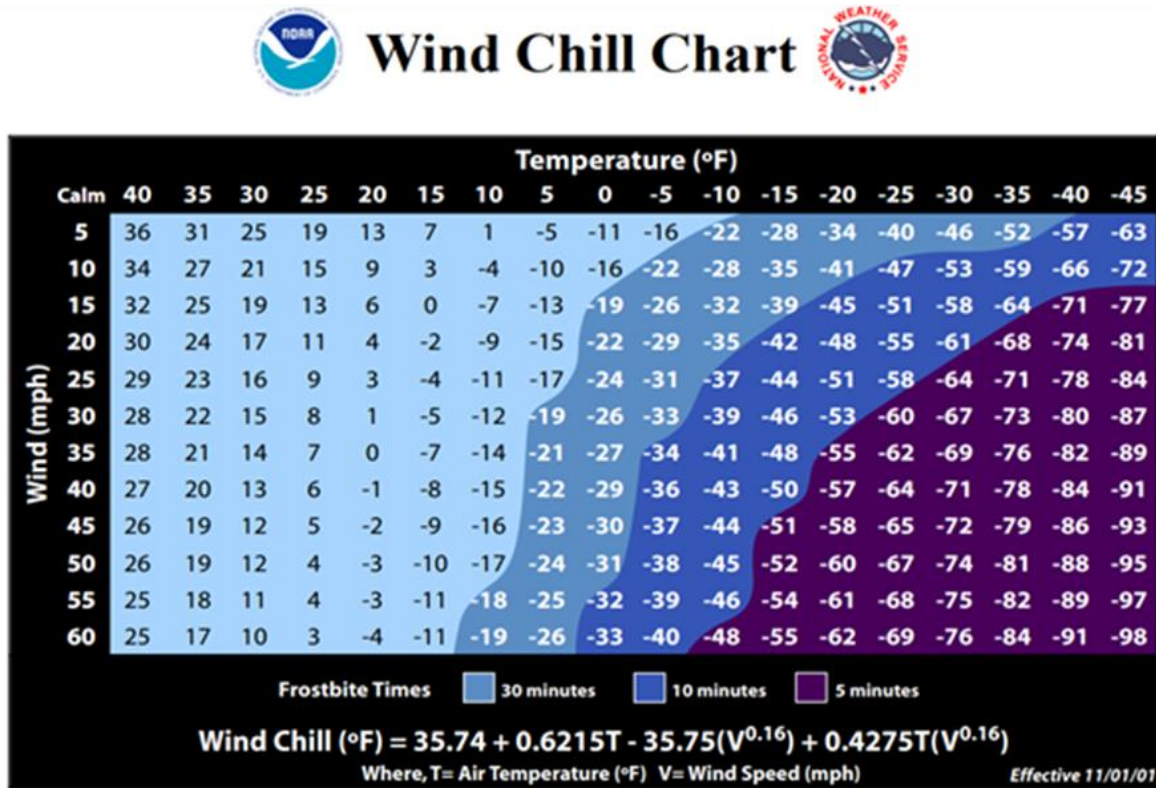
Hazard/Problem Description

Definition: A prolonged period of excessively cold weather and the sudden intrusion of very cold air over a large area.

Description: While the seasonal cold temperatures routinely experienced in the Westminster area have little impact on the built environment and critical infrastructure, they can pose a significant danger to the homeless and other vulnerable populations. Hypothermia and/or frostbite can occur at moderately cold temperatures, especially when compounded by wind. While the effects of cold temperatures on the built environment are largely mitigated by appropriate building codes and resilient infrastructure, prolonged extreme cold can over-stress or damage power and water infrastructures.

In 2001, NWS implemented an updated Wind Chill Temperature index, illustrated in Figure 4-19 below. This index was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature. The NWS will issue a wind chill warning for the Denver/Boulder area when wind chills of at least -25°F are forecasted on the plains or wind chills of at least -35°F are forecasted in the mountains or foothills. A freeze watch is issued when freeze conditions are possible in the following 12 to 36 hours.

Figure 4-19 National Weather Service's Wind Chill Chart



Source: National Weather Service

The coldest temperature recorded for the Westminster area is -30°F. The area has recorded 22 days of -20°F or below weather since 1987.¹ The last time the Denver area experienced -20°F or below temperatures was December 2022 (NWS, 2023).² Table 4.19 below summarizes the daily extremes and averages for the NWS station 055984 in Northglenn, Colorado, the closest NWS station to Westminster.

Table 4-19 General Climate Summary – Temperature

Metric	Measurement
Winter Average Minimum Temperature	19.4°F
Winter Mean Temperature	33.0°F
Summer Average Maximum Temperature	86.8°F
Summer Mean Temperature	71.2°F
Minimum Temperature	-30°F on February 1, 1987
Maximum Temperature	110°F on August 2, 2008
Average Annual Number of Days >90°F	45.8
Average Annual Number of Days <32°F	150.9

¹ "Daily data for a month." NOWData. NOAA's National Weather Service, accessed March 31, 2023, <https://www.weather.gov/wrh/climate?wfo=bou>.

²"First/last dates." NOWData. NOAA's National Weather Service, accessed March 31, 2023, <https://www.weather.gov/wrh/climate?wfo=bou>.

Source: WRCC3
 Station ID: 055984 (Northglenn, CO)
 Period of Record: 1984-2012
 Winter = December, January, and February
 Summer=June, July, and August

Past Occurrences

While the NCEI database does not contain records of events on a city scale, it does record events on a county or geographic zone scale. Table 4.20 below details NCEI extreme cold/wind chill events from Westminster area.

Table 4-20 NCEI Recorded Extreme Cold Events

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
W. Adams County	12/18/1996	1	-	-	-
Denver Metropolitan Area	12/18/1998	5	15	-	-
Denver Metropolitan Area	4/11/2001	-	-	\$3,100,000	-
W. Adams County	3/17/2003	-	2	\$15,500,000	-
W. Adams County	11/10/2014	-	-	-	\$10,000,000
W. Adams & Jefferson Counties	2/1/2011	-	-	-	-
W. Adams & Jefferson Counties	12/21/2022	1	-	-	-

December 18, 1996: Overnight temperatures in Denver dipped to 9 below zero. A homeless man was found unconscious in his car suffering from exposure. The man's body temperature was 85°F when he was discovered. He died several hours later.

December 18-22, 1998: During a period of six consecutive days, an Arctic airmass moved into the northeastern region of Colorado, causing a significant drop in overnight temperatures. On the morning of the 22nd, temperatures reached a low of 19 degrees below zero. As a result, multiple individuals, primarily homeless, were treated for hypothermia at local healthcare facilities, while the extreme cold led to at least five fatalities. Of these, three individuals perished directly due to exposure. The frigid conditions also resulted in intermittent power outages, and once the cold spell had ended, thawing water pipes within several residential and commercial properties burst, causing severe destruction. No estimate of the damage, however, is available.

February 1-4, 2011: Arctic air caused temperatures to drop significantly in the Front Range Urban Corridor, resulting in pipe bursts, water damage, and school closures. At Denver International Airport overnight low temperatures on the 1st through the 3rd were -13°F, -17°F, and 0°F respectively. The water damage caused by the pipe bursts was widespread, affecting various buildings, including businesses, apartments, and assisted care facilities. At the county courts administration building in Jefferson County, a steady stream of water from a crack on the 5th floor went unnoticed on February 3rd and flooded all floors of the administration wing overnight.

December 21-23, 2022: An arctic polar vortex outbreak caused some of the coldest temperatures in northeast Colorado in 30 years, impacting several regions in the US. Temperatures dropped by 75°F, resulting in wind chill temperatures ranging from -25°F to -54°F. Denver saw one fatality and opened warming shelters, while power outages affected 6,400 customers along the I-25 Corridor. Storm totals in the mountains and foothills ranged from 4 to 13 inches, highest at Eldora Ski Area. Across the urban

³ "Cooperative Climatological Data Summaries," Western Regional Climate Center, accessed 31 March 2023, <http://wrcc.dri.edu/climatedata/climsum/>

corridor and northeast plains, storm totals ranged from 3 to 9 inches. At Denver International Airport, 3.9 inches of snowfall was observed, with 6.0 inches at the National Weather Service Office in Boulder.

Numerous school districts and county government buildings were closed on the 22nd. At Denver International Airport, 645 flights were canceled and another 922 were delayed. The following day, 264 flights were canceled, and an additional 253 flights were delayed. Denver firefighters responded to hundreds of calls related to burst pipes in buildings and homes following the arctic freeze. Ten buildings on the University of Colorado Boulder campus were impacted by a power interruption, which resulted in widespread damage that included flooding from burst pipes.

Geographical Area Affected

One of the defining features of temperature hazards is that they tend to be regional in nature, impacting a large geographical area simultaneously. This is due to the limited geographical extent of the City, which means that temperature hazards have the potential to affect most, if not all, of the planning area at the same time. The impact of temperature hazards on the planning area is reflected in the record of past events, which consistently discusses the greater geographical area affected by these hazards. Rather than singling out the City of Westminster, the record highlights the regional nature of temperature hazards. This makes the geographical area affected **EXTENSIVE**.

Magnitude/Severity

Extreme cold is considered to have **critical** magnitude and severity. As previously noted in the Hazard/Problem Description section Wind Chill Temperature index can be used to describe the extent of extreme cold. The coldest temperature recorded for the Westminster area is -30°F and it is reasonable to assume this level of cold could be experienced in the future. While the NCEI storm database lists only seven extreme cold events for the Westminster area, there have been at least seven deaths and 17 injuries stemming from those events. During those events, \$18.5 million in property damage and an additional \$10 million in crop damage was incurred.

While many extreme cold events may result in minimal human harm or infrastructure damage, there are potential secondary impacts associated with lost time, maintenance costs, and damaged building contents. Even a minor event of extreme cold can have a significant impact on city resources, necessitating the activation of shelters, severe weather plans, and other measures.

Frequency/Likelihood of Occurrence

Different data sources capture different events during the same time period, and often different information specific to the same events. The NCEI table above summarizes seven extreme cold weather events that have occurred in the greater Westminster area from 1998 to 2022; however, none of these events resulted in a federal disaster declaration. This makes predicting the future occurrence of such events difficult; however, the observed frequency of these events, as well as the increased probability of such events with the acceleration of climate change, makes the likelihood of extreme cold events **likely**.

Climate Change Considerations

Climate change is projected to increase the uncertainty of weather patterns and produce more extreme climate-induced events. The polar vortex is well documented and is described as large areas of low pressure and cold air surrounding the North and South poles. Increased temperatures in the polar regions have weakened and destabilized the jet stream leading polar air to dip into lower latitudes, bringing it farther south than typical (UC Davis).⁴ Science suggests that these changes in the jet stream may lead to increased polar vortex events in Colorado, like the December 2022 event profiled above.

⁴ "Polar Vortex." UC Davis. The Regents of the University of California, Davis, November 5, 2021. <https://www.ucdavis.edu/climate/definitions/what-is-the-polar-vortex>.

Vulnerability Summary

Extreme cold poses a danger to vulnerable populations (AFN, homeless and low-income) as well as property (broken pipes) and vegetation. The conjunction of extreme cold and a prolonged loss of power or gas service would pose a significant hazard.

People

Extended power outages during extreme cold events may make many homes and offices unbearably cold. Vulnerable populations are particularly susceptible to power outages, which can have life threatening consequences. According to the US Department of Health and Human Services emPOWER Program, 12.3% of Medicare beneficiaries in Adams County and 11.4% of Medicare beneficiaries in Jefferson County rely on electricity-dependent medical and assistive equipment, such as ventilators, to live independently in their homes.

Extreme cold also poses a significant risk to people experiencing homelessness, as these individuals are limited in their ability to seek shelter. Winter weather and low temperatures require the activation of shelters and severe weather plans to protect this population. At the time of the Adams County 2022 Point in Time homelessness count, there were an estimated 462 people experiencing homelessness in Adams County, including 188 individuals who were unsheltered and therefore may face greater exposure to extreme cold. In Jefferson County, the 2022 Point in Time count yielded 493 people experiencing homelessness, with 187 people being unsheltered.⁵

With poor road conditions, sheltering residents may present significant logistical challenges with getting people to heated facilities, feeding, and providing medical care. These situations, accompanied by stranded motorists that need to be rescued, represent significant threats to the population of the planning area. Additionally, during extended wintertime power outages, people often make the mistake of bringing portable generators inside and not venting them properly, leading to carbon monoxide poisoning.

Property

The potential vulnerability of inventory assets to extreme cold is dependent on several factors, including the age of the building, building type, construction material used, and the condition of the structure. There is extensive record of extreme cold temperatures causing pipes to freeze and burst in the Westminster area, often causing significant water damage. Older buildings, which are often not built to the most updated building codes, are most at risk of damage from extreme cold events. Setting building code requirements for new development to ensure greater resistance to the freeze and thaw effects of extreme cold events will minimize vulnerability of future development.

Critical Facilities

The greatest issue for critical facilities during significant severe cold weather storms is primarily inaccessibility due to poor roadways, utility outages, or dangerous wind chills. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption

Water and fuel shortages

- Road closures
- Damaged infrastructure components
- Service interruptions in water supply, gas supply, and drainage

During periods of heavy snow, ice, or blizzards, roads can quickly become impassable, stranding motorists and isolating communities. Freezing temperatures and repeated freeze-thaw events can cause

⁵ Metro Denver Homeless Initiative. "Regional Breakdown." 2022 Point in Time Count, Public Tableau, 24 Jan. 2022, <https://public.tableau.com/app/profile/mdhi/viz/MDHI2022PointinTimeCount/Overview>.

potholes which may result in additional hazardous travel conditions if not tended to promptly. Long term road closures during an extended cold period may diminish and threaten propane and fuel supplies.

Economy

Closure or travel delays on the Interstate highways or at Denver International Airport can affect the movement of goods and people through the planning area and impact the local economy. Even short-term closures of local roads, businesses, and government buildings may result in economic disruptions.

Severe cold weather events often require shelter activation and response activities, which have a significant impact on local resources. Repair to any damage incurred due to the severe cold event will also have a toll on economic resources.

Historical, Environmental, Cultural Resources

Sudden and unseasonable cold snaps can also damage or kill large numbers of trees. In a 1991 event, the Westminster area experienced a 64°F change (from 71°F to 7°F) between October 27 and October 29. During a 2014 event, temperatures dropped from 64°F on November 10 to -13°F on November 12, a 77°F change in temperature. Both events severely damaged or killed many trees. The 2014 event involved one of the warmest falls on record and one of the most intense extratropical cyclones ever recorded in the North Pacific. The cyclone, a remnant of Typhoon Nuri, moved into the Bering Sea causing the jet stream to move northward and allowing the polar vortex to fall into the United States (Geist, 2015.).⁶ The 2014 event is an example of how a warming global climate can result in sudden extreme cold weather events (Walsh, 2014).⁷

As noted previously, older, historic buildings could potentially be more vulnerable to structural damage from extreme cold.

Development Trends

All future structures built in the planning area will be exposed to extreme cold weather events. Facilities with backup generators are better equipped to handle a severe weather situation should the power go out. As development pressures increase and new construction speeds up in the area, the City of Westminster must continue to adhere the best available building code standards to account for the impacts of adverse weather.

4.3.8 Extreme Heat

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Extreme Heat	C	5	3	4	C5

Hazard/Problem Description

Definition: The Colorado State Hazard Mitigation Plan defines extreme heat as “temperatures over 90 degrees for an extended period of time, or that hover 10 degrees or more above the average high temperature for the region and last for multiple consecutive days” (2018).

Description: As is the case of other hazards that are not specific to geography, the entire building inventory and population in the city is potentially exposed. As with extreme cold, extreme heat poses the

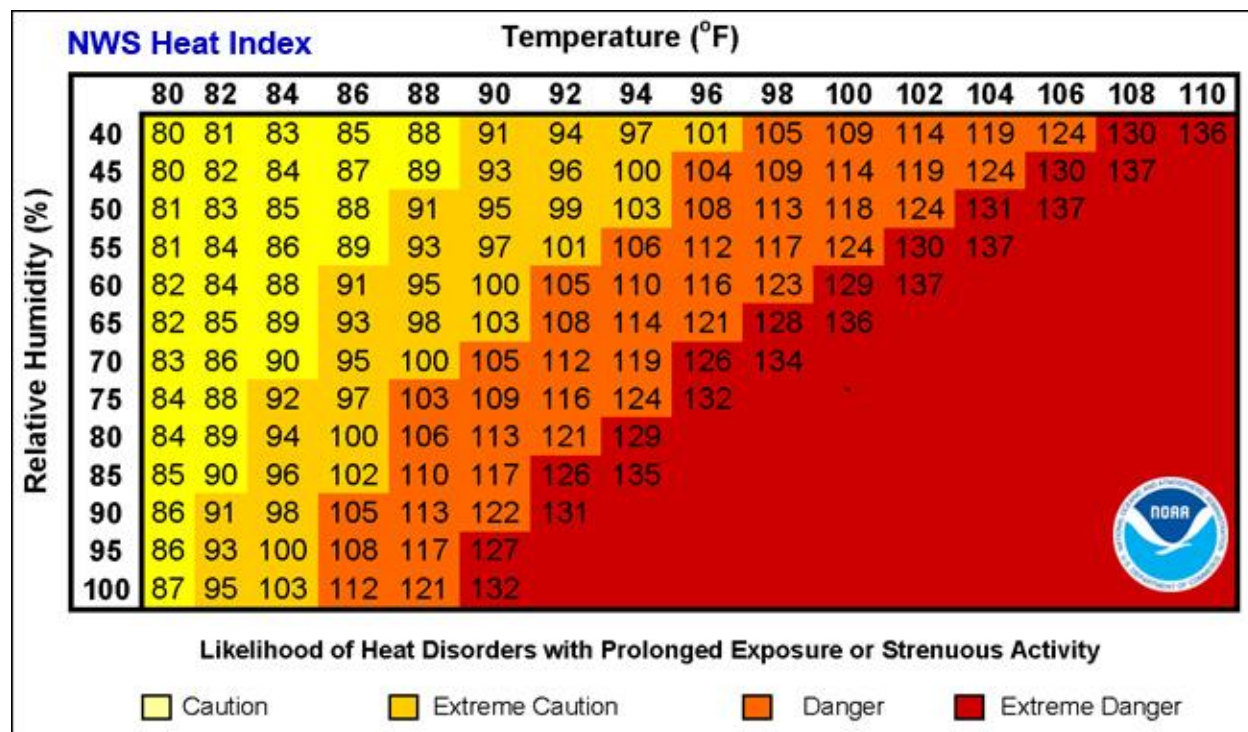
⁶ Geist, S.D. 2015 Freezing Temperatures Brought on by a Typhoon in the Philippines Impact Landscapes in the Rocky Mountain Region. Rocky Mountain Arborist (55) 3 11 – 12

⁷ Walsh, Bryan. 2014. *Ecocentric*. Jan 6. Accessed Feb 7, 2018. <http://science.time.com/2014/01/06/climate-change-driving-cold-weather/>

greatest hazard to vulnerable populations, especially the young and elderly. Extreme heat can also over-stress and potentially disrupt the power grid.

NOAA's Heat Index measures the severity of hot weather by estimating how hot it feels to humans. By combining air temperature and relative humidity, the Heat Index is directly related to skin temperature. The ambient temperature is quantified by examining the relation between relative humidity versus skin temperature. If the relative humidity is higher (or lower) than the base value, the apparent temperature is higher (or lower) than the ambient temperature. Figure 4-20 shows how ambient temperature and relative humidity impact the relative intensity of heat conditions.

Figure 4-20 National Weather Service's Heat Index Chart



Temperatures in the high 90s and low 100s are not unusual in Westminster. The lower humidity, altitude and weather patterns help to mitigate extreme heat, but many homes in Colorado do not have air conditioning. The hottest temperature recorded for the Westminster area is 110°F on August 2, 2008 (see Table 4-19).

Past Occurrences

While the NCEI database does not contain records of events on a city scale, it does record events on a county or geographic zone scale. Table 4.21 below details NCEI extreme heat events from the Westminster area.

Table 4-21 NCEI Recorded Extreme Heat Events

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Denver Metropolitan Area	6/29/2000	-	-	-	-
E. Jefferson & W. Adams Counties	7/1/2000	-	-	-	-

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Denver Metropolitan Area	9/16/2000	-	-	-	-
Denver Metropolitan Area	9/17/2000	-	-	-	-
W. Adams County	6/1/2012	-	-	-	-

June 29 – July 15, 2000: June 29th marked the beginning of a near record hot streak for the Denver area. The maximum high temperature at Denver International Airport equaled or exceeded 90°F for 17 consecutive days, one day short of tying the all-time record. The record of 18 consecutive days was set in two different years, July 1st-18th, 1874 and July 6th-23rd, 1901.

June 1-30, 2012: June 2012 was the hottest June in Denver since weather records began back in 1872. There was a total of seventeen 90°F days in the month of June. The highlight of month was a stretch of five consecutive 100°F days from the 22nd to the 26th. This was only the third time in Denver weather history in which this happened. Two of the high temperatures during the stretch peaked at 105°F, which set the all-time record for the month of June and also tied the all-time maximum temperature for Denver.

June 28, 2018: we experienced a record high temperature of 105 degrees. In 2020, the metro area experienced a record 128 days of 80 degrees and above and a record of 75 days of temperatures of 90 degrees and above. Our increasing homeless population, medically vulnerable, and economically challenged residents are most at risk. Extreme heat events pose a hazard to critical infrastructure. <https://www.extremeweatherwatch.com/cities/denver>

Geographical Area Affected

One of the defining features of temperature hazards is that they tend to be regional in nature, impacting a large geographical area simultaneously. This is due to the limited geographical extent of the City, which means that temperature hazards have the potential to affect most, if not all, of the planning area at the same time. The impact of temperature hazards on the planning area is reflected in the record of past events, which consistently discusses the greater geographical area affected by these hazards. Rather than singling out the City of Westminster, the record highlights the regional nature of temperature hazards. This makes the geographical area affected **extensive**.

Magnitude/Severity

Although extreme heat events in Westminster are considered to have **limited** magnitude and severity, the secondary impacts of extreme heat can increase the threat to the area. As previously noted in the Hazard/Problem Description section NOAA's Heat Index measures the severity of hot weather by estimating how hot it feels to humans. The hottest temperature recorded for the Westminster area is 110°F on August 2, 2008 and it is reasonable to assume this level of heat could be experienced in the future. The NCEI storm database reports three separate extreme heat events in the area, with which there were no associated injuries, deaths, or damages. However, a federal emergency declaration for wildfire in Jefferson County occurred on June 12, 2000, and lasted through June 25, 2000. This event is separate from the NCEI's June 29, 2000, extreme heat event, but it is likely that the heat conditions leading up to the events primed the area for the wildfire. Therefore, even though extreme heat events may pose negligible harm in Westminster, their secondary impacts have the potential for serious consequences.

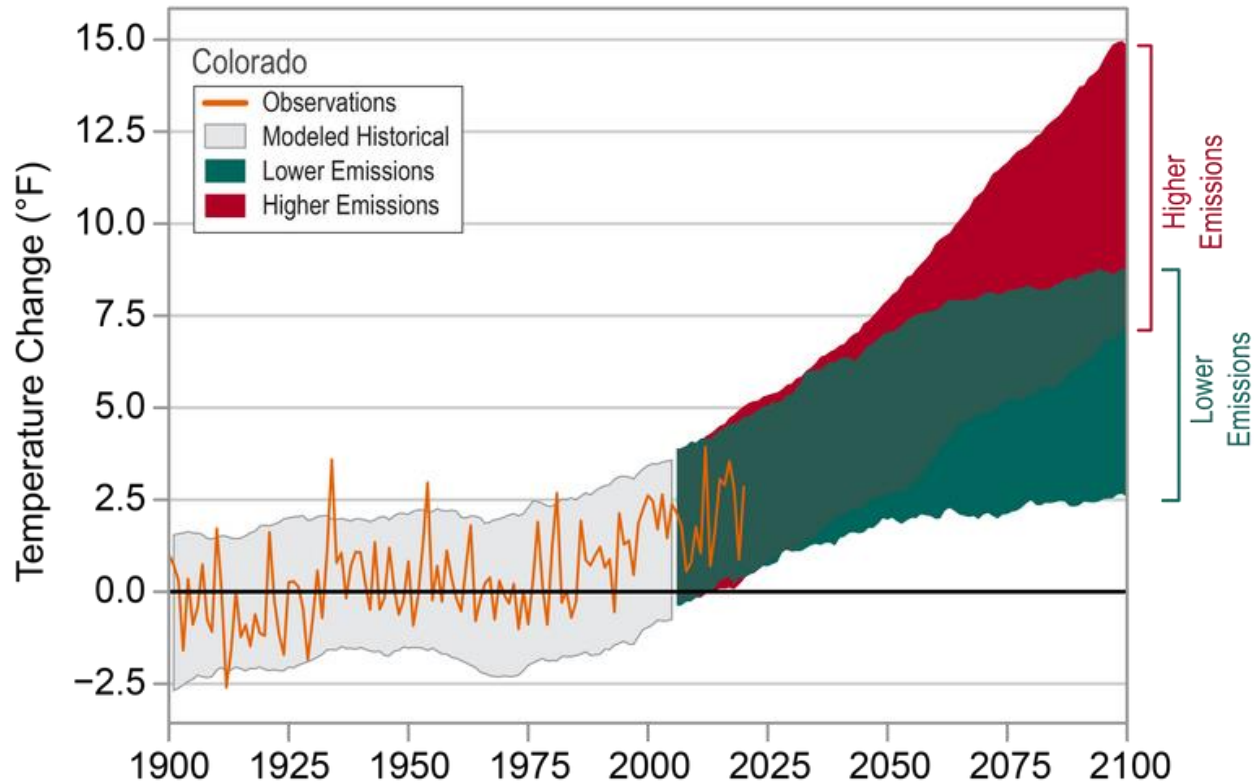
Frequency/Likelihood of Occurrence

Different data sources capture different events during the same time period, and often different information specific to the same events. The NCEI table above summarizes three extreme heat weather events that have occurred in the greater Westminster area from 2000 to 2012. While these numbers alone result in a low rate of occurrence, the general trend of warming seen in Colorado (see Climate Change Considerations) indicates that such events will become more frequent. This makes the likelihood of extreme heat events **likely**.

Climate Change Considerations

Temperatures in Colorado have risen about 2.5°F since the beginning of the 20th century (Frankson et al., 2022).⁸ Warming has occurred in all four seasons and has been characterized by an above average occurrence of very hot days since 2000. Historically unprecedented warming is projected to occur during this century. Less warming is expected under a lower emissions future (the coldest end-of-century projections being about 2°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest end-of-century projections being about 11°F warmer than the hottest year in the historical record; red shading) (Frankson et al., 2022).

Figure 4-21 Observed and Projected Temperature Change in Colorado



Source: Frankson et al., 2022

Warming temperatures are projected to exacerbate the recent trend of reduced overall water availability and earlier snowmelt and runoff. Projected warming will increase the rate of soil moisture loss during dry spells, increasing the intensity of future naturally occurring droughts. As a result, the frequency and severity of wildfires are projected to increase in Colorado.

Vulnerability Summary

Prolonged exposure to extreme heat and physical activity can cause a range of health issues such as heatstroke, sunstroke, cramps, exhaustion, and fatigue. Urban areas are particularly susceptible to these risks due to air stagnation and the abundance of heat-absorbing material, such as streets and buildings. In addition to health concerns, extreme heat can also result in structural damage and failure, such as distortion of roadways and railroad tracks. While buildings and public facilities are generally not directly

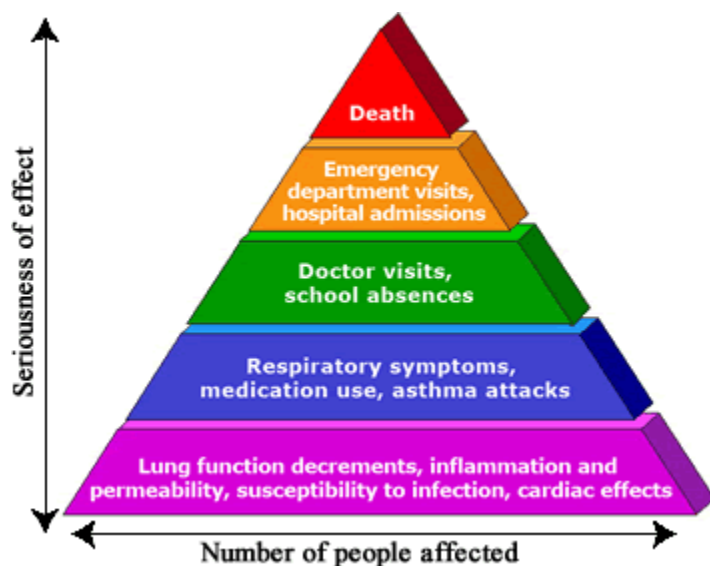
⁸ Frankson, R., K.E. Kunkel, L.E. Stevens, D.R. Easterling, N.A. Umphlett, C.J. Stiles, R. Schumacher, and P.E. Goble, 2022: Colorado State Climate Summary 2022. NOAA Technical Report NESDIS 150-CO. NOAA/NESDIS, Silver Spring, MD, 5 pp.

impacted by extreme heat, there can be indirect negative effects, such as power outages or strain on a community's utilities to meet the demand for cooling during extreme heat events.

People

Extreme temperatures can pose a serious threat to human health, especially when adequate protection and exposure to harsh elements are not provided. In response to these risks, the State of Colorado has identified specific populations as being especially vulnerable during extreme temperature conditions. Vulnerable populations can be identified through situational and physical characteristics, such as physical or mobility constraints, cognitive impairments, economic constraints, and social isolation, as highlighted by the US EPA. Additionally, individuals living or working in buildings without cooling systems are at greater risk. Populations living in densely populated urban areas are particularly susceptible to extreme heat events due to air stagnation and the abundance of heat-absorbing materials. In addition to health risks, elevated temperatures can also increase the rate of ground-level ozone formation, which can lead to adverse health effects associated with urban smog.

Figure 4-22 Effects of Ground-level Ozone



Source: US EPA⁹

Property

Typically, the only impact extreme heat has on general building stock is increased demand on air conditioning equipment, which in turn may cause strain on electrical systems. Excessive heat events can cause failure of motorized systems such as ventilation systems used to control temperatures inside buildings.

Critical Facilities

Prolonged heat exposure can have significant impacts on infrastructure. Prolonged high heat exposure increases the potential of pavement deterioration, as well as railroad warping or buckling. High heat also puts a strain on energy systems and consumption, as air conditioners are run at a higher rate and for longer. Extreme heat can also reduce transmission capacity over electric systems.

⁹ "Health Effects of Ozone in the General Population." EPA. Environmental Protection Agency, August 26, 2022. <https://www.epa.gov/ozone-pollution-and-your-patients-health/health-effects-ozone-general-population>.

Economy

Extreme heat can exert significant impacts on Westminster's economy, both in the short- and long-term. In the short-term, extreme heat may lead to direct or indirect disruptions in commerce as people stay sheltered to avoid the temperatures, and it may trigger a surge in energy demand. In the long-term, extreme heat can result in elevated water and energy usage, higher building maintenance costs, climate-induced workforce migration and business relocation, warming of water systems affecting aquatic species and human recreation, and a potential rise in water costs. Prolonged exposure to extreme heat may trigger a secondary hazard, such as drought, which could further exacerbate issues related to water availability and usage.

Historical, Environmental, Cultural Resources

Extreme heat can cause an increase in water temperatures in streams, rivers, and lakes. During storm events, increased and warmer runoff from impervious surfaces into streams can lead to a degradation of habitat. This impairs water quality and compromises aquatic species' metabolism and reproduction. Elevated water temperatures can inhibit aquatic life, especially if a species can only survive in a small range of water temperatures. The effects of the thermal pollution are highly dependent upon air temperature conditions before the storm, suggesting that as temperatures in Colorado rise, the impacts from heat pollution will also rise (Herb et al, 2008).¹⁰

Increasing temperatures may also cause species to shift habitats in elevation and latitude, and extended periods of extreme heat can stress both flora and fauna species. Extreme heat may cause temporary drought-like conditions. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. According to Colorado Parks and Wildlife, warmer temperatures can also lead to earlier snowmelt, affecting insect and wildlife life cycles as well as seed production and germination.¹¹

Development Trends

As fluctuations in temperature typically do not directly impact structures, the potential effects of extreme heat on future development are less pronounced compared to other hazards profiled in this plan. However, proactive measures such as constructing environmentally-friendly buildings that require less energy for cooling, implementing effective insulation for pipes and electrical wiring, and strategically designing walkways, parking structures, and pedestrian zones to minimize exposure to extreme temperatures may enhance the resilience of buildings and the community to variations in temperature. With continued development, the population may increase, thereby raising the number of people who are potentially exposed to temperature variations. Therefore, public education efforts should persist to help the community understand the risks and vulnerabilities associated with outdoor activities, property maintenance, and regular exposure to extreme heat. As urban development progresses in Westminster, the urban heat island may expand, potentially increasing the likelihood of extreme heat events. However, green infrastructure or low-impact development may serve as mitigating measures to alleviate the impact of extreme heat events.

4.3.9 Flooding

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Flooding	D	3	3	3	D4

¹⁰ Herb, William R., Ben Janke, Omid Mohseni, and Heinz G. Stefan. "Thermal pollution of streams by runoff from paved surfaces." *Hydrological Processes: An International Journal* 22, no. 7 (2008): 987-999.

¹¹ "Climate Change and Severe Weather." Colorado Parks and Wildlife. State of Colorado. Accessed April 3, 2023. <https://cpw.state.co.us/conservation/Pages/CON-Climate-Change-Weather.aspx>.

Hazard/Problem Description

Definition: An event where water levels rise over the tops of river/creek banks due to excessive rain, snowmelt or ice dams. They can occur rapidly (flash flooding) and may be due to upstream events such as heavy rain, dam failure or the sudden release of water by debris or ice jam. (N. S. Laboratory, Severe Weather 101-Floods n.d.)

Most of the city sits within the catchment of the headwaters of Big Dry Creek. Standley Lake is fed primarily through the Farmer’s Highline Canal and Church Ditch, which bring water from Clear Creek near the City of Golden. Although this topographic factor limits our flooding hazard, intense rain events (2-3 inches in one hour), or rain events that result in five or more inches of rain can produce rapidly flowing water and have the potential to result in 100-year or greater flood events. These short-duration 1-hour rainfall events have a one-percent annual chance of occurring. A 2013 storm over neighboring Boulder, Denver and Aurora exceeded 13 inches over multiple days and caused many dams to spill. During the past 50 years, Colorado has experienced several events that exceeded 8 inches per 24-hours. (UDFCD-Stewart, Mar. 23, 2017) For a more detailed examination of major precipitation events, see “Severe Summer Storms,” below.

A local rain event exceeding 1.5 inches per hour will result in localized street flooding and fast running water. Although the Standley Lake has a small natural catchment area, an intense local rain event could result in flooding in the area between the dam and the BNSF railroad embankment approximately 1 mile downstream. The flooding could be exacerbated by any impedance of stream flows under Wadsworth Boulevard or the BNSF embankment. Roughly 1,400 properties encroach the floodplain. While not considered part of the regulatory floodplain, these properties are still considered high risk for flooding. (MARPLOT estimate) Neighborhoods along our four primary drainages (Big Dry Creek, Little Dry Creek, and Walnut Creek and Quail Creek/Northeast Floodway) are susceptible to high water due to severe winter storm snow melt or heavy localized rain. Our flood damage potential is low to moderate due to flood mitigation efforts and infrastructure. High numbers of visitors and recreational enthusiasts at Standley Lake and along Big Dry Creek increase the number of people that may be affected and in need of warning and evacuation.

Past Occurrences

Since 1965 Westminster has seen six (6) federally declared disasters due to flooding and according to NCEI data \$137.587M in property damage and \$2.020M in crop damages due to flooding, with 4 deaths associated as well. These events for Adams and Jefferson counties and Westminster specifically are shown in Table 4.22 and Table 4.23 below.

Table 4-22 Adams and Jefferson County FEMA Federally Declared Flood Events 1965 – Present

Declaration Number	Year Declared	Incident Type	Declaration Title	County
DR-4229-CO	2015	Flood	Severe Storms, Tornadoes, Flooding, Landslides, And Mudslides	Adams
DR-4145-CO	2013	Flood	Severe Storms, Flooding, Landslides, And Mudslides	Adams, Jefferson
EM-3365-CO	2013	Flood	Severe Storms, Flooding, Landslides, And Mudslides	Adams, Jefferson
DR-385-CO	1973	Flood	Heavy Rains, Snowmelt and Flooding	Adams, Jefferson
DR-261-CO	1969	Flood	Severe Storms & Flooding	Adams, Jefferson
DR-200-CO	1965	Tornado	Tornadoes, Severe Storms & Flooding	Adams

Source: Fema.gov

Table 4-23 Adams and Jefferson County National Centers for Environmental Information (NCEI) Flood Events 1965 – Present

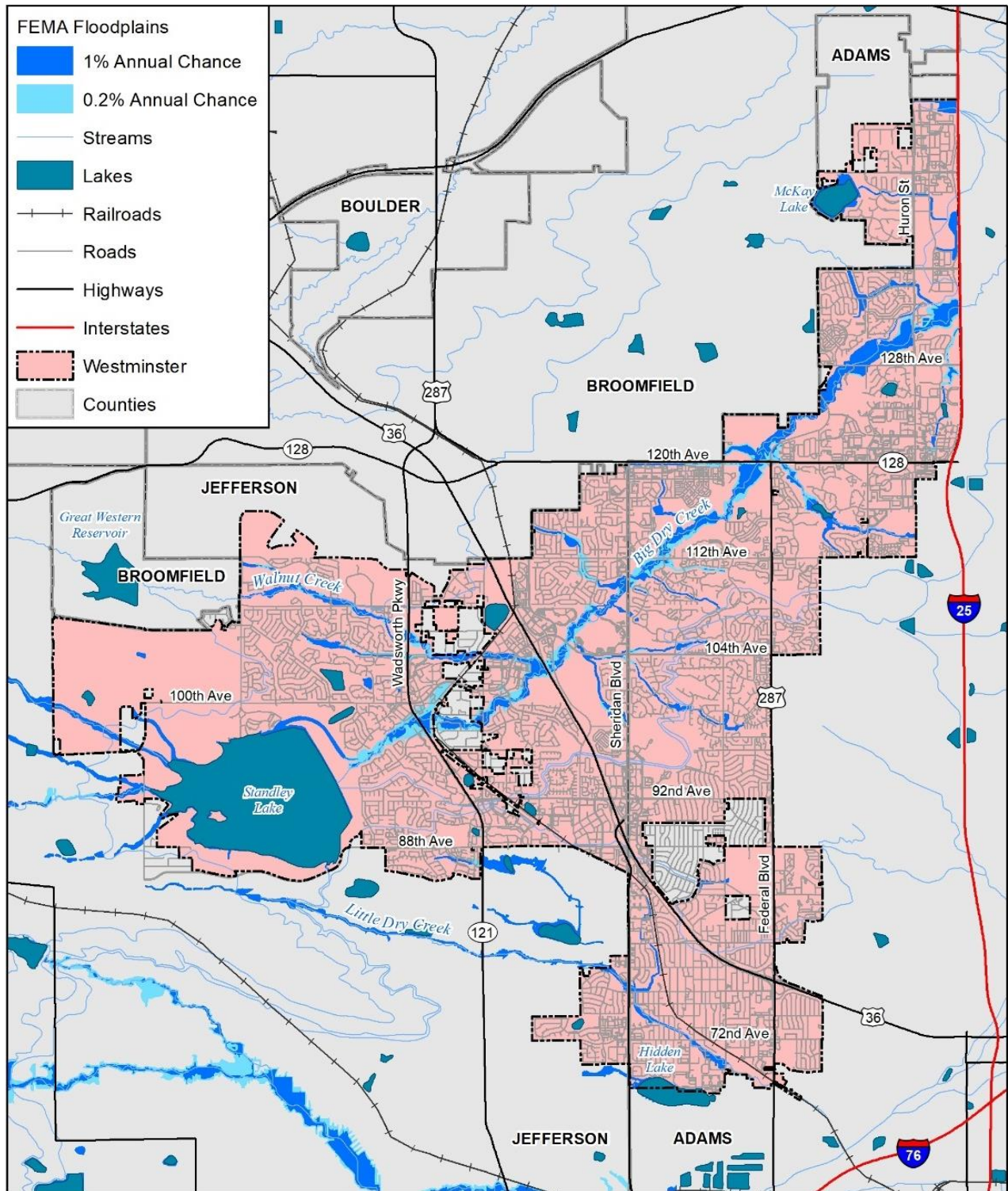
Location	County	Date	Type	Death	Injury	Property Damage	Crop Damage
Westminster	Adams Co.	7/29/1997	Flood	0	0	\$20,000	\$0
Westminster	Adams Co.	8/4/1997	Flood	0	0	\$0	\$0
Westminster	Adams Co.	8/30/2016	Flash Flood	0	0	\$0	\$0

Source: NCEI

Geographical Area Affected

A flood vulnerability assessment was performed for the City of Westminster within Adams and Jefferson counties using GIS. The city’s building footprint and parcel data as well as the County’s associated assessor’s building improvement valuation data were used as the basis for the inventory. Westminster’s effective National Flood Hazard Layer was used as the hazard layer. NFHL is FEMA’s flood risk data that depicts the 1% annual chance (100-year) and the 0.2% annual chance (500-year) flood events. NFHL data for Adams, Boulder, Broomfield, and Jefferson counties were downloaded from the FEMA Flood Map Service Center on September 02, 2022, and determined to be the best available floodplain data.

Figure 4-23 City of Westminster FEMA Flood Hazards



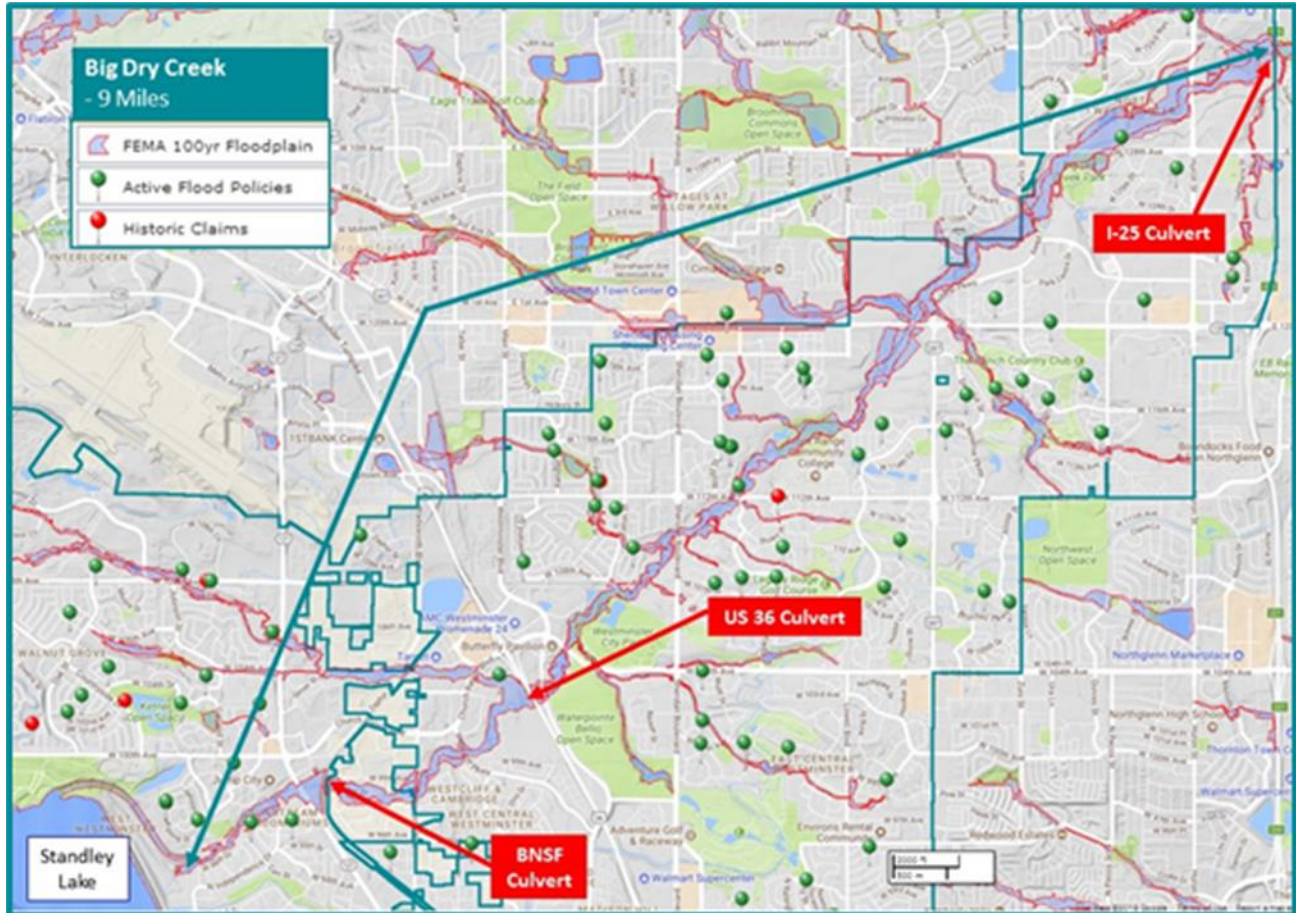
Map compiled 11/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
FEMA NFHL Effective 9/2/2022

0 1 2 Miles



Big Dry Creek is a perennial stream that originates in the open spaces west of Standley Lake. This waterway flows from southwest to northeast across approximately 9 miles of Westminster. Three culverts (BNSF Railroad embankment, US 36 and I-25) are undersized for major storm flows on this waterway. The flood hazard posed by this waterway has been largely mitigated by improvements to the Standley Lake dam and spillway, culvert improvements and the use of open space to limit development.

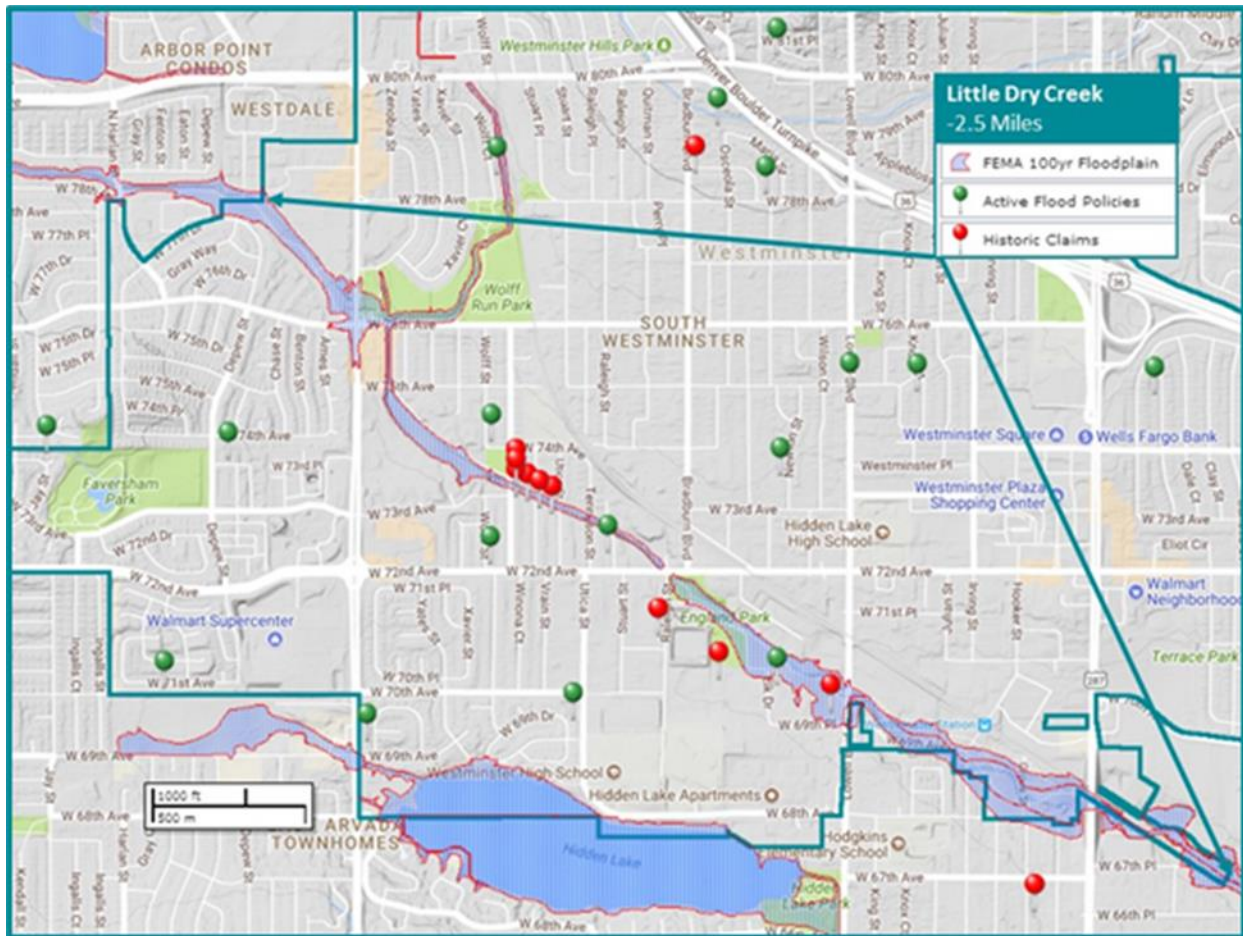
Figure 4-24 Big Dry Creek 100-year Floodplain



Source: City of Westminster

Little Dry Creek is an intermittent stream that runs for approximately 8 miles from 84th and Alkire to its terminus in Clear Creek. Approximately 3 miles of this waterway runs through southern Westminster. There are approximately 9 historic flood claims and 7 active flood insurance policies associated with this waterway. There are approximately 1,329 properties associated with its floodplain. However, there are no residential or commercial structures located in the regulatory floodplain. The flooding hazard posed by Little Dry Creek has been significantly mitigated through channel improvement projects and the use of open space. There are numerous culverts that could create a backwater condition, if obstructed.

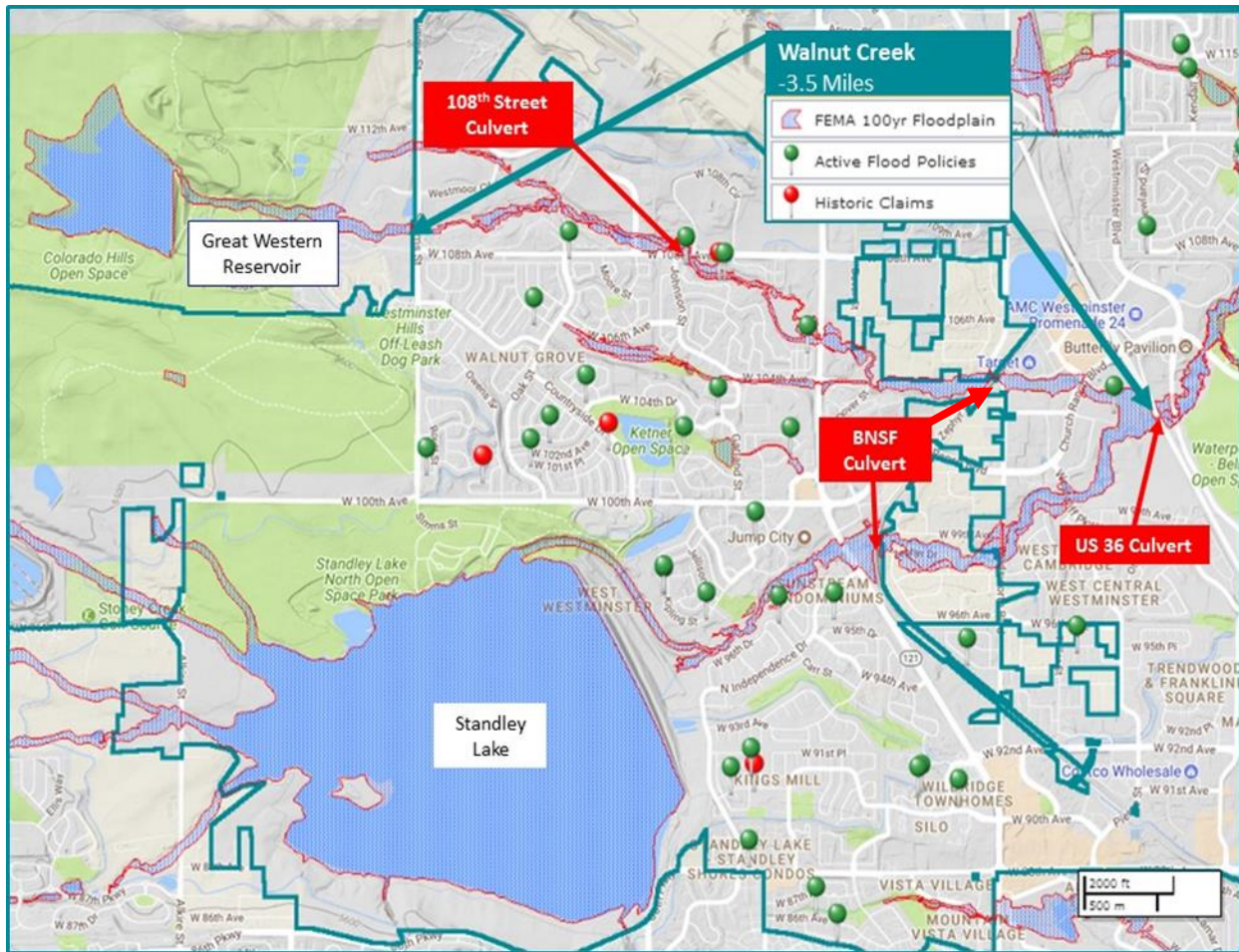
Figure 4-25 Little Dry Creek 100yr Floodplain



Source: City of Westminster

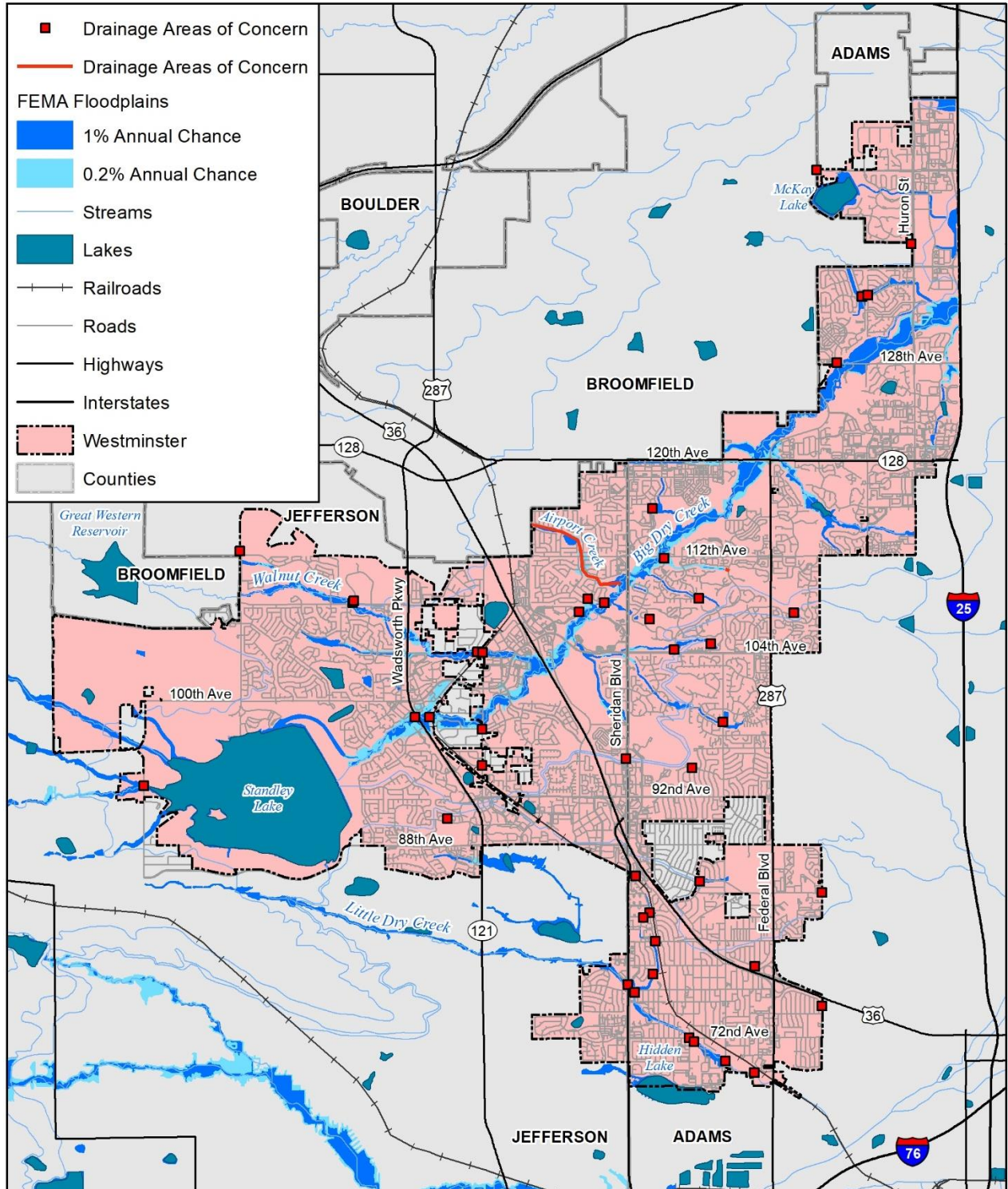
Walnut Creek is an intermittent stream that originates in the foothills approximately 4 miles west of the city. Several small tributaries flow into the Great Western Reservoir which is approximately 1 mile upstream of the western edge of the city. Walnut Creek flows eastward for approximately 3.5 miles through central Westminster and enters Big Dry Creek near 103rd and US 36. Three culverts (108th Street, Union Pacific Railroad embankment, and US-36) are potential chokepoints for this waterway. Culvert improvement and the use of open space have been used to mitigate the flood hazard associated with this waterway.

Figure 4-26 Walnut Creek 100yr Floodplain

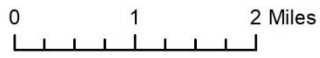


Source: City of Westminister

Figure 4-28 City of Westminster Drainage Areas of Concern and FEMA Flood Hazards



wsp Map compiled 3/2023;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
FEMA NFHL Effective 9/2/2022



Magnitude/Severity

Magnitude and severity can be described or evaluated in terms of a combination of the different levels of impact that a community sustains from a hazard event. Specific examples of negative impacts from flooding on the City of Westminster span a comprehensive range and are summarized as follows:

- Floods disrupt transportation and critical infrastructure;
- Floods cause damage to private property that often creates financial hardship for individuals and families;
- Floods cause damage to public infrastructure resulting in increased public expenditures and demand for tax dollars;
- Floods cause loss of personal income for agricultural producers that experience flood damages;
- Floods cause loss of income to businesses relying on recreational uses of city waterways;
- Floods cause emotional distress on individuals and families; and
- Floods can cause injury and death.

The terms 1% annual chance flood and 0.2% change annual flood, described above as measures of geographic area affected, are also used as a way to describe magnitude. As previously noted in the description section intense rain events (2-3 inches in one hour), or rain events that result in 5 or more inches of rain can produce rapidly flowing water and have the potential to result in 100-year or greater flood events. These short duration 1-hour rainfall events have a one-percent annual chance of occurring. A local rain event exceeding 1.5 inches per hour will result in localized street flooding and fast running water. Much of the 1% annual chance floodplain has limited development, but a 0.2% flood would have greater impacts as described further in the Vulnerability Summary section.

Frequency/Likelihood of Occurrence

Flooding will continue to occur in Westminster, with minor urban flooding on an annual basis. However, the city has taken measures to reduce the risk presented by historic large magnitude flooding caused by the watersheds in the area. There have also been numerous warning notifications programs implemented to warn the City of Westminster of potential flooding.

The NCEI database records a total of three flooding/flash flooding events in Westminster's jurisdiction between 1950 and 2023. Based on this historic rate of occurrence, Westminster has effectively nearly a 25% chance of flooding or flash flooding in a given year. While the majority of those floods are minor and cause little damage, the probability of future damaging floods is still likely.

Climate Change Considerations

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Climate change is already impacting water resources, and resource managers have observed the following:

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

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes

in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

Vulnerability Summary

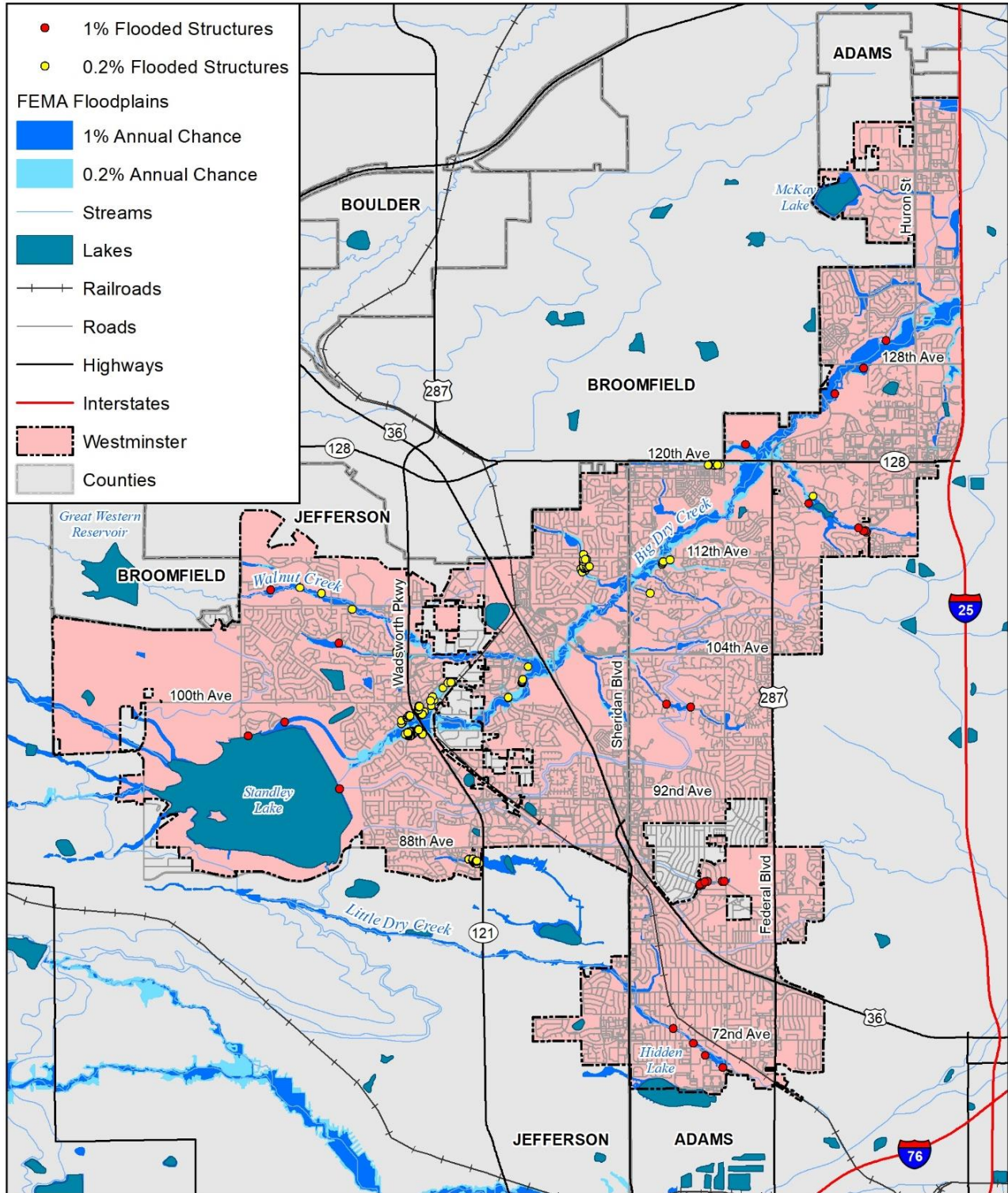
People

Population counts of those living in the floodplain were generated by analyzing County assessor and parcel data that intersect with the 100-YR and 500-YR floodplains identified on FIRMs. Using GIS, US Census Bureau information was used to intersect the floodplain and an estimate of population was calculated by weighting the population within each census block and tract with the percentage of flood risk area. Using this approach, it was estimated that the total exposed population consists of 35 people within the 100-YR floodplain and an additional 267 more within the 500-YR floodplain, as shown in tables Table 4-24 and Table 4-25 below.

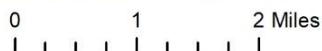
Property

Figure 4-29 shows the structures at risk of the 1% and 0.2% annual chance of flooding within the City of Westminster.

Figure 4-29 City of Westminster FEMA Flood Hazards and Structures



Map compiled 2/2023;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
FEMA NFHL Effective 9/2/2022



Parcels with improvement values greater than zero were used in the analysis, which assumes that improved parcels have a structure of some type. The FEMA NFHL flood zones were overlaid in GIS on the building footprint data to identify structures that would likely be inundated during a 1% annual chance and 0.2% annual chance flood event. Building improvement values and counts for those points were then extracted from the parcel/assessor's data and summed by land use type.

Based on this analysis Westminster has 24 buildings with a total value of over \$27 million exposed to the 1% annual chance flood. There are 23 improved parcels and also over \$15 million in improvement valuations. This analysis does not account for buildings that may be mitigated to the 1% annual chance flood in accordance with local floodplain regulations. Content values are estimated to be nearly \$13 million in estimated losses in regard to the one-percent annual chance, and if the FEMA 1% annual chance of flooding was to occur it would cause nearly \$7 million in property damages. Damage from flooding is typically proportional to the depth of flooding in the structure. According to FEMA depth-damage relationships, a two-foot-deep flood can result in damage equivalent to 25% of a structure's value. These statistics are highlighted in Table 4-21 below.

Table 4-24 Westminster FEMA 1% Annual Chance Flood Risk by Property Type

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value	Estimated Loss	Population
Commercial	1	2	\$286,007	\$286,007	\$572,014	\$143,004	
Exempt	8	8	\$9,928,803	\$9,928,803	\$19,857,606	\$4,964,402	
Residential	14	14	\$5,018,831	\$2,509,416	\$7,528,247	\$1,882,062	35
Total	23	24	\$15,233,641	\$12,724,226	\$27,957,867	\$6,989,467	35

Source: Jefferson and Adams County Assessor Data 2022, FEMA NFHL Effective 9/2/2022, WSP GIS Analysis

The City of Westminster's 0.2% FEMA annual chance of flood risk shows a markedly higher risk than the 1% flood risks. There is a total of 157 buildings with a total value of over \$271 million exposed to the 1% annual chance flood. There are also 120 improved parcels and over \$166 million in improvement valuations. Content values are estimated to be over \$105 million. If the FEMA 1% annual chance of flooding was to occur, it would cause nearly \$68 million in property damages. This is reflected in Table 4-22 below.

Table 4-25 Westminster FEMA 0.2% Annual Chance Flood Risk by Property Type

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value	Estimated Loss	Population
Commercial	17	48	\$44,568,752	\$44,568,752	\$89,137,504	\$22,284,376	
Exempt	1	1	\$364,486	\$364,486	\$728,972	\$182,243	
Multi-Family	5	10	\$43,493,598	\$21,746,799	\$65,240,397	\$16,310,099	25
Residential	97	98	\$77,783,106	\$38,891,553	\$116,674,659	\$29,168,665	242
Total	120	157	\$166,209,942	\$105,571,590	\$271,781,532	\$67,945,383	267

Source: Jefferson and Adams County Assessor Data 2022, FEMA NFHL Effective 9/2/2022, WSP GIS Analysis

National Flood Insurance Program

There are currently 65 active National Flood Insurance Program (NFIP) policies in Westminster that provide \$37,090 in coverage for both buildings and contents. Since 1981, 39 NFIP claims have been filed for a total of \$260,098.41 in total net payments to NFIP policy holders. The full flood insurance policy data for Westminster is shown in Table 4.26 below.

Table 4-26 NFIP Coverage and Claims, City of Westminster

Jurisdiction	Date Joined	Effective Firm Date	Current Policies	Number of Losses	Total Net Payments	Coverage (\$)	Total Written Premium + FPF
City of Westminster (Adams Co.)	9/30/1988	12/20/2019	42	34	\$260,098.41	\$28,854	\$687
City of Westminster (Jefferson Co.)	9/30/1988	12/20/2019	23	5	\$0.00	\$8,236	\$358
Total			65	39	\$260,098.41	\$37,090	\$1,045

Source: FEMA Community Details – State & Community Drilldown as of January 26, 2023

Repetitive Loss Properties

A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. Westminster has a total of three repetitive loss properties that have a combined total of 11 losses. From these losses there has been a total of \$122,948.02 in building payments and \$92,193.24 in content payments, summarized in Table 4.27 below. There are currently no severe repetitive loss properties in Westminster.

Table 4-27 Repetitive Loss Data, City of Westminster

Jurisdiction	RL Properties	Total Losses	Total Building Payments	Total Content Payments
City of Westminster	3	11	\$122,948.02	\$92,193.24

Source: FEMA Community Details – Westminster Repetitive Loss Summary as of January 26, 2023

Critical Facilities

Westminster has a total of 33 critical facilities located in or near the Special Flood Hazard Area (SFHA). 29 of these 33 Lifeline Critical facilities are located with the 1% annual chance floodplain. 27 are located in the transportation sector and consist of non-scour bridges, 10 of which are in fair condition, 16 in good condition and one scoured bridge that is also in good condition. This is showcased in Table 4.28 below. Potential bridge and road elevations above the associated base flood elevation (BFE) heights would help to mitigate and protect the City of Westminster’s transportation infrastructure.

Table 4-28 Critical Facilities at Risk to FEMA 1% Flood Hazards by Category

Category	Count
Communications	2
Energy	-
Food, Water, Shelter	-
Hazardous Material	-
Health and Medical	-
Safety and Security	-
Transportation	27
Total	29

Source: City of Westminster, CDPHE, CEPC, HIFLD, NBI, FEMA NFHL, WSP GIS Analysis

The four remaining Lifeline Facilities within Westminster’s 0.2% annual chance of flooding or Zone X(shaded) consists of two safety and security facilities, one of which is a fire station and the other a private school. The other two Lifelines with the 0.2% annual chance floodplain are in the transportation sector. One bridge is a non-scour fair condition bridge and the other is a non-scour bridge in good condition. The results for these facilities are highlighted in Table 4.29.

Table 4-29 Critical Facilities at Risk to FEMA 0.2% Flood Hazards by Category

Category	Count
Communications	-
Energy	-
Food, Water, Shelter	-
Hazardous Material	-
Health and Medical	-
Safety and Security	2
Transportation	2
Total	4

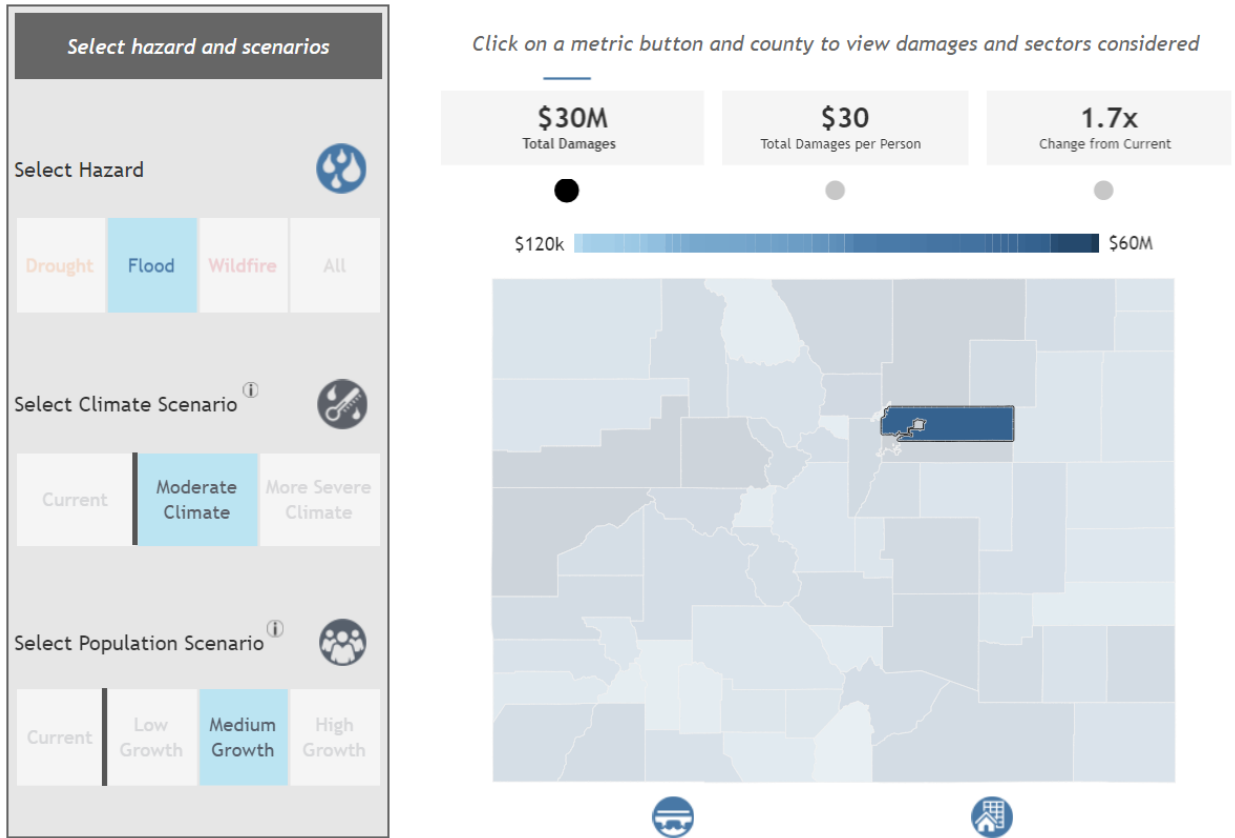
Source: City of Westminster, CDPHE, CEPC, HIFLD, NBI, FEMA NFHL, WSP GIS Analysis

Economy

Flooding can have a major economic impact on the economy, including indirect losses such as business interruption, lost wages, and other downtime costs. Flooding often coincides with the busy summer tourism months in Westminster. Even the threat of flooding can have an impact. This was observed during the flooding event in 2015 when local business was down more than normal due to anticipated flooding.

The Colorado Water Conservation Board FACE tool provides an assessment of the potential impacts of flooding under various future growth and climate scenarios. Impacts are reported in terms of expected annual damages: the expense that would occur in any given year if monetary damages from all hazard probabilities and magnitudes were spread out over time (units = 2019 dollars). The FACE tool analysis is only available at county scales but is required by the State of Colorado for hazard mitigation plans; Adams County was chosen as the representative county for the purposes of this Plan. According to CWCB FACE analysis tool, Adams County could potentially experience \$30 million in future losses due to flooding under medium population growth and moderate climate scenarios. This is shown in Figure 4-30 below.

Figure 4-30 Adams County CWCB FACE Tool Results – Flooding

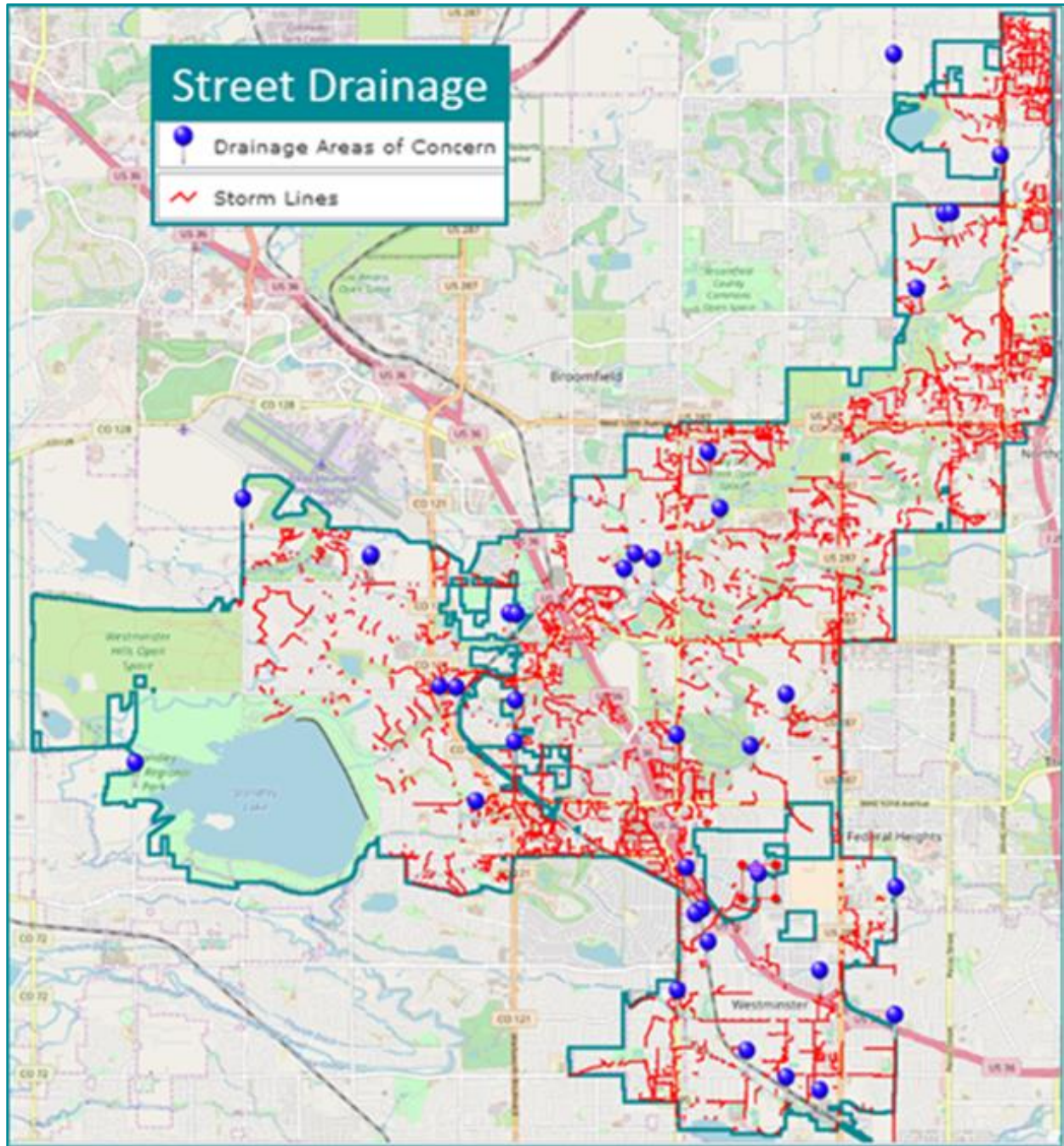


Source: Colorado Water Conservation Board, <https://cwcb.colorado.gov/FACE>

Historical, Environmental, Cultural Resources

Street flooding related to significant rainfall, hail or rapid snow melt is possible in Westminster. The city’s storm water system includes over 9,000 storm inlets, manholes and associated storm water lines that convey storm water runoff to our natural drainages. The city has also identified 36 drainage sites of concern for inspection and maintenance.

Figure 4-31 Street Drainage Infrastructure and Areas of Concern



Development Trends

Most development that has occurred has been residential and built to the local floodplain management regulations (lowest floor 1 foot above the base flood elevation; no residential property allowed in 1% zone). Vulnerability to floods greater than the 1% annual chance flood (base flood), such as the 0.2% flood, has decreased due to this development. The City of Westminister currently has several developments either under review, construction approved or completed. New construction with Westminister's floodplain will adhere to the preestablished floodplain regulations that are in place.

4.3.10 Dam Failure

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Dam Failure	A	3	4	5	A5

Hazard/Problem Description

Dams are humanmade structures built for a variety of uses, including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they usually are engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped, which is when water passes over the top of the dam. Overtopping can lead to dam failure and is the primary cause of earthen dam failure in the United States. Dam failures can also result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which result in overtopping
- Earthquake/seismic activity
- Inadequate spillway capacity resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping or rodent/wildlife activity
- Improper design
- Improper maintenance
- Negligent operation

Westminster sits at the headwaters of Big Dry Creek which transects the city southwest to northeast. Walnut Creek and Little Dry Creek are smaller drainage basins. Walnut Creek flows into Big Dry Creek while Little Dry Creek drains to the southeast into Clear Creek. Several manmade reservoirs are associated with these drainage basins. In addition to the limited local catchments, water is supplied to the primary water reservoir (Standley Lake) by a ditch running from Clear Creek near Golden. Several other ditches, legacies of the area's agricultural past, continue to flow through the city.

Dam inundation can also occur from non-failure events, such as when outlet releases increase during periods of heavy rains or high inflows. Controlled releases to allow water to escape when a reservoir is overflowing actually can help prevent future overtopping or failure. When outlet releases are not enough, spillways are designed to allow excess water to exit the reservoir and prevent overtopping. This can protect the dam but result in flooding downstream. Additionally, outlets and spillways may release water in a different direction than a dam failure, creating additional inundation areas.

The Colorado Dam Safety Branch developed a tool in recent years that can support public awareness, planning, and emergency preparedness and response involving high hazard dams across the state. This tool evaluates dams and their capabilities regarding operational and flood release functions to prevent or minimize potential future damages (Flood Hazard Mitigation Plan for Colorado 2018). The Colorado Dam Safety Branch rules and regulations require owners of High and Significant hazard dams in the state to develop and maintain Emergency Actions Plans (EAPs) and file them with Boulder, Jefferson and Adams County Emergency Managers. EAPs enable notification and response to dam safety emergencies and contain inundation mapping that portrays the limits of flood inundation for the sunny-day (absent flooding) failure scenario.

Non-Failure Inundation

The Colorado DNR has studied the potential for non-failure dam inundation statewide to show potential areas of flooding where outlet capacity exceeds the downstream channel capacity. Dams are ranked as high, moderate, or low likelihood for outlet releases to cause conditions that could require an emergency response to reduce potential downstream consequences. The ranking is based on a statewide database of high hazard dams that includes 441 high hazard dams that have been analyzed by the Colorado DNR for this aspect of dam incident flooding. The high, moderate, or low designations were assigned by DNR by dividing the total number of ranked dams across the state into thirds. Should there be a need to relieve pressure on the dam (e.g., if there was excess inflow from high rains or snowmelt) releases from the dams ranked as high or moderate may result in downstream flooding. The dams at the highest risk of non-failure inundation are noted in the Geographical Area Affected section.

Regulatory Oversight

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

Colorado Rules and Regulations for Dam Safety and Dam Construction

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

U.S. Army Corps of Engineers Dam Safety Program

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

Federal Energy Regulatory Commission Dam Safety Program

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

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

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

FERC monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must

undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

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

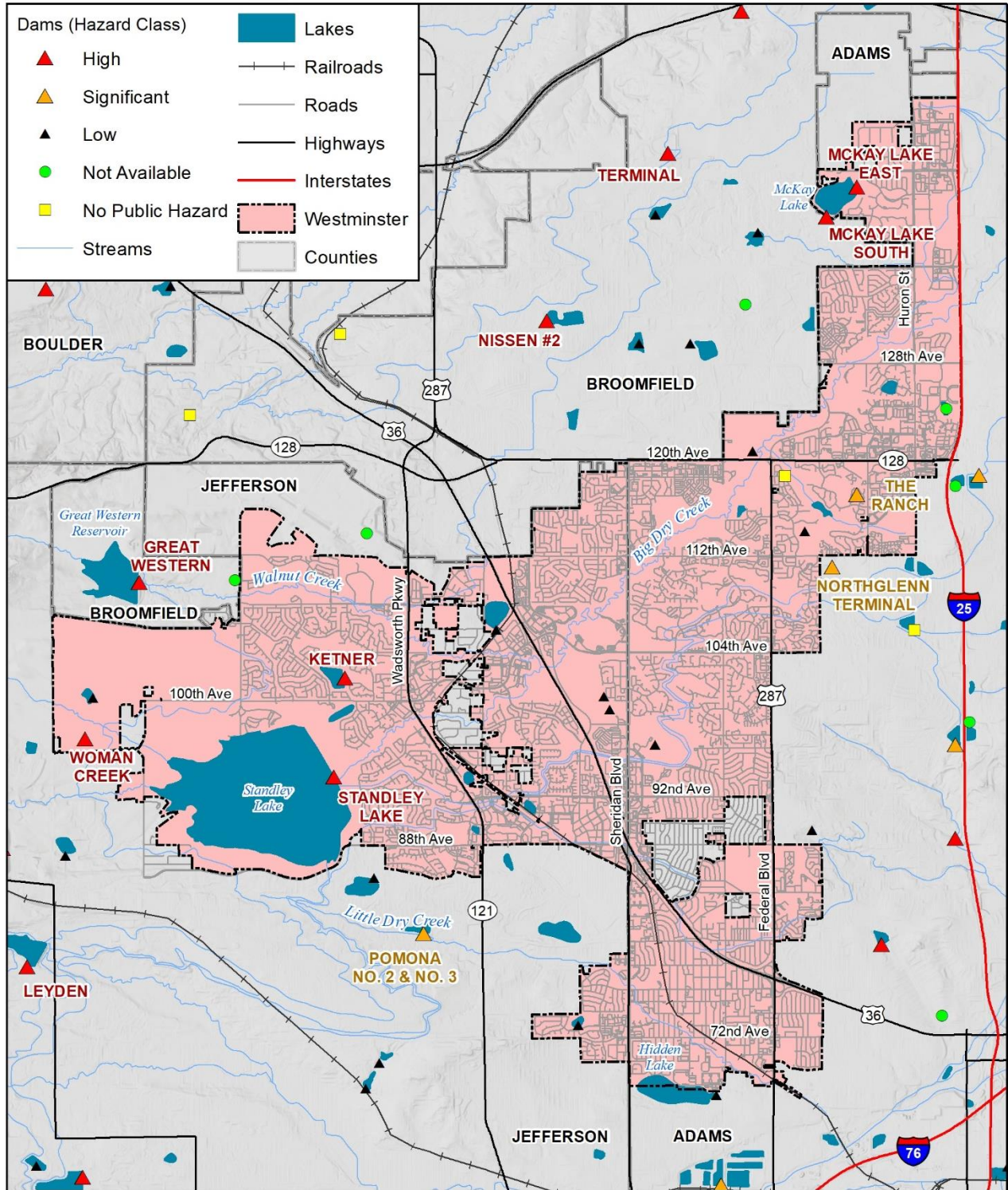
Low Head Dams

Low head dams are engineered structures built into and across stream and river channels for a variety of purposes. Water flows over low head dams continuously, as they span from one riverbank to the other. Low head dams generally range in height from 1-15 feet. Historically, low head dams were built to divert water from streams to support industrial, municipal, and agricultural water usage. Low head dams are also engineered to prevent erosion and degradation of stream channels. More recently, low head dams have been engineered to provide recreational amenities for boating, rafting, and tubing and also to improve aquatic habitat.

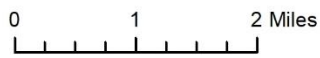
Low-head dams are a hazard because water flowing over low head dams produces dangerous recirculating currents that can trap recreators. Rafters, kayakers, and those floating our rivers for recreation are often unaware of these structures and the dangers resulting from them. Low head dams can be difficult to detect by uneducated river users approaching from upstream due to their height, and the fact that the relatively tranquil pool they create provides no indication of the dangers just beyond the visual horizon created by the dam and ponded water. This can limit reaction time and boaters' ability to exit the river upstream of the dam.

According to the Colorado Division of Natural Resources, public safety at low head dams is becoming an increasingly important issue as the population of Colorado increases and citizens recreate more and more on waterways within the state. Safety measures can include anything from upstream signage recommending portage, modifications to the existing structure to eliminate the recirculating current, or removal if the structure is no longer serving its original purpose. Low head dams should not be mistaken for low hazard significance dams. The dams located in the City of Westminster are shown in Figure 4-34 below.

Figure 4-32 City of Westminster Dams



Map compiled 12/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
Colorado DWR Dam Safety



Past Occurrences

To determine previous occurrences of dam failure within the City of Westminster, the 2018 Westminster Hazard Mitigation Plan and the Colorado Division of Natural Resources database was reviewed. No record of dam failure within Westminster’s boundaries were found.

Geographical Area Affected

The City of Westminster has six dams located within its jurisdiction. Five dams are considered high hazard dams. The Ketner Dam is located within close proximity to both commercial and residential areas within the study area. Standley Lake Dam is located at the end of Big Dry Creek and at the eastern portion of Standley Lake. The McKay Lake East and South Dams are located along McKay Lake in the north portion of Westminster and are located next to higher populated areas of the study area. Four other high hazard dams that are outside of city limits but could affect the city include: Fortune, Great Western, Nissen #2, and Terminal dams. Woman Creek Dam is a check dam to capture runoff from Rocky Flats, located on the western edge of the city above Standley Lake. The Ranch dam is the only significant hazard dam within the city’s jurisdiction and is located in the northeast portion of the city in close proximity to a highly populous area. The Northglenn Terminal dam is falls just outside Westminster’s jurisdiction and is located just south of the Ranch Dam.

Non-Failure Dam Incidents

The dams at the highest risk of non-failure inundation are shown in Table 4-30 below. The high, moderate, or low designations were assigned by DNR by dividing the total number of ranked dams across the state into thirds. Should there be a need to relieve pressure on the dam (e.g., if there was excess inflow from high rains or snowmelt) releases from the dams ranked as high or moderate may result in downstream flooding.

Table 4-30 High Hazard Dams with Outlet Release Flood Potential in Planning Area

County	Dam ID	Dam Name	Outlet Description	Max Outlet Release Capacity (cfs)	Composite Ranking	Outlet Release Ranking
Jefferson	020326	Standley Lake	New Outlet Constructed 2004, 2 - 72" Dia Steel Intake Pipes, 102" Tunnel Along Toe	700	7	High
Adams	060202	Mckay Lake - East	2.5' Conc. Enc. Steel	175	56	High
Jefferson	020633	Woman Creek	30" Steel & Rcp	75	62	High
Jefferson	020635	Fortune	30 Inch Steel Pipe Encased In Concrete	107	187	Moderate
Broomfield	020212	Great Western	24" Steel	40	196	Moderate
Jefferson	020226	Ketner	12" Cmp W/ Insituform Liner	6	210	Moderate
Broomfield	020411	Nissen #2	18" Steel	22	265	Moderate
Broomfield	060315	Terminal Storage Reservoir	48" Steel Pipe W/ 18" By-Pass	11	311	Low
Adams	060324	Mckay Lake - South	2.5 Steel Pipe Located At East Dam (060202)	0.0001	367	Low

Source: DWR High Hazard Dam Release – Downstream Floodplain Impacts Study

Magnitude/Severity

Critical – Standard practice among federal and state dam safety offices is to classify a dam according to the potential impact a dam failure (breach) would have on downstream areas. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental and lifeline facilities. Per the US Army Corps of Engineers and National Inventory of Dams standards, dams are classified in three categories that identify the potential hazard to life and property, and one that indicates unknown risk:

- **High** hazard indicates that a failure has the potential to result in the loss of life.
- **Significant** hazard indicates that a failure could result in appreciable property damage and loss of life is not expected.
- **Low** hazard indicates that failure would result in only minimal property damage and loss of life is unlikely.
- **No Public Hazard (NPH)** dam failure damage is limited to the dam owners' property and has minimal impact downstream.

Westminster has a total of nine (9) high hazard dams and one (1) significant hazard dam that have dam inundation in and around the City of Westminster. This can make the potential for loss of life and property damage likely if a failure was to occur. The inundation areas for each of the dams are generally downstream and include rural and urban areas below the dams. The extent of impacts depends on the nature of failure and location of the dam. The largest population potentially at risk is located near the Standley Lake Dam. It should also be noted that due to the dam inundations overlapping some of the populations accounted for can be counted more than once in the GIS parcel analysis.

Speed of Onset: A dam failure event's speed of onset can range from sudden, with little warning time prior to the release of dangerous flood flows, to an event that gradually unfolds.

Duration: A spring or summer storm involving heavy rain can lead to a flash flood within six hours of the beginning of the event. Dam failure initiated because of extreme rainfall can occur within hours of an extreme rain event. Flooding from a non-dam failure flood event could last for several days depending on the amount of water needing to be released to relieve pressure on the dam.

Frequency/Likelihood of Occurrence

There is no reported history of dam or levee failure in the City of Westminster. High Hazard dams are routinely inspected by the CO DWR. As a result, there is an overall low probability of dam or levee failures impacting Westminster. Therefore, the probability rating has been determined to be Unlikely.

Climate Change Considerations

The potential for climate change to affect the likelihood of dam failure has been incorporated into the 2020 Rules and Regulations for Dam Safety and Dam Construction. The climate-change related Rule is based on a state-of-the-practice regional extreme precipitation study completed in 2018. (DWR, 2018). This study determined a very high likelihood of temperature increases, resulting in increased moisture availability to extreme storms. As such, an atmospheric moisture factor of 7% is required to be added to estimates of extreme rainfall for spillway design.

Vulnerability Summary

A dam incident can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is confined to the areas and populations subject to inundation downstream of the structure. Secondary losses could include loss of the multi-use functions of the dam itself and associated revenues that accompany those functions, as well as damage to roads, utilities, and other infrastructure. GIS analysis was carried out using dam inundation extents from the Colorado Dam Safety Program as well as the Jefferson and Adams County parcel data (from the Assessor's Office), and the critical facility/infrastructure inventory. In this process, asset data was overlaid with the dam inundation layers to arrive at total units or facilities at risk.

People

Dam or levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake.

Persons located underneath or downstream of a dam are at risk of a dam failure, though the level of risk can be tempered by topography (specifically where populations are located within the inundation path of a dam), amount of water in the reservoir and time of day of the breach. Injuries and fatalities can occur from debris, bodily injury, and drowning. Once a dam has breached, standing water presents all the same

hazards to people as floodwater from other sources. People in the inundation area may need to be evacuated, cared for, and possibly permanently relocated. Impacts could include thousands of evacuations and likely hundreds of casualties, depending on the dam involved.

The populations most vulnerable are those that have the least time to evacuate and need assistance. Populations that may need assistance to evacuate include the elderly, disabled and young. The vulnerable population also includes those who may not have an adequate warning about evacuation from emergency notification systems. The loss of life is impacted by the amount of early warning time first responders and the public has prior to the incident.

Table 4.30 showcases the 17,041 people located next to a high or significant hazard dam in or near the City of Westminster. Standley Lake has the largest amount of people located next to a high or significant dam with 9,418 total. This is followed by Great Western dam which is not directly in Westminster's jurisdiction with 2,263 people. Fortune Dam has the third highest population of people at risk with 2,263 people total.

Table 4-31 People at Risk to Dam Failure Westminster

Dam Name (Hazard Class)	Population
Fortune (High Hazard)	2,023
Great Western (High Hazard)	2,263
Ketner (High Hazard)	1,376
McKay Lake East (High Hazard)	373
McKay Lake South (High Hazard)	52
Pomona No.2 and No.3 (Significant Hazard)	0
Standley Lake (High Hazard)	9,418
Terminal Storage Reservoir (High Hazard)	1,536
Woman Creek (High Hazard)	0
Total	17,041

Source: Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Property

Communities located below a high or significant hazard dam and along a waterway are potentially exposed to the impacts of a dam failure. High hazard potential dams threaten lives and property, while significant hazard potential dams threaten property only. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) are produced for many high hazard potential dams. The high or significant hazard dams contained dam inundation extents in a spatial form that were analyzed to quantify risk across the planning area. Table 4-32 through Table 4-40 shows the number and values of parcels and structures for overlapping inundation layers for dams with a potential to impact the planning area. Total building exposure numbers were based on 2022 county assessor data.

Table 4-32 Fortune Dam (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	26	65	\$117,871,327	\$117,871,327	\$235,742,654
Exempt	6	6	\$38,227,982	\$38,227,982	\$76,455,964
Multi-Family	2	392	\$79,733,639	\$39,866,820	\$119,600,459
Residential	426	427	\$191,075,447	\$95,537,724	\$286,613,171
Total	460	890	\$426,908,395	\$291,503,852	\$718,412,247

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-33 Great Western Dam (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	23	99	\$165,038,981	\$165,038,981	\$330,077,962
Exempt	6	6	\$38,227,982	\$38,227,982	\$76,455,964
Multi-Family	138	214	\$109,103,276	\$54,551,638	\$163,654,914
Residential	702	702	\$199,122,659	\$99,561,330	\$298,683,989
Total	869	1,021	\$511,492,898	\$357,379,931	\$868,872,829

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-34 Ketner Dam (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	33	97	\$58,532,214	\$58,532,214	\$117,064,428
Multi-Family	2	392	\$79,733,639	\$39,866,820	\$119,600,459
Residential	165	165	\$74,002,907	\$37,001,454	\$111,004,361
Total	200	654	\$212,268,760	\$135,400,487	\$347,669,247

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-35 McKay Lake East Dam (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Agricultural	1	1	\$14,285	\$14,285	\$28,570
Commercial	8	41	\$28,927,213	\$28,927,213	\$57,854,426
Exempt	1	1	\$409,205	\$409,205	\$818,410
Residential	151	151	\$105,147,783	\$52,573,892	\$157,721,675
Total	161	194	\$134,498,486	\$81,924,595	\$216,423,081

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-36 McKay Lake South (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Agricultural	1	1	\$14,285	\$14,285	\$28,570
Commercial	8	41	\$28,927,213	\$28,927,213	\$57,854,426
Exempt	1	1	\$409,205	\$409,205	\$818,410
Residential	151	151	\$105,147,783	\$52,573,892	\$157,721,675
Total	161	194	\$134,498,486	\$81,924,595	\$216,423,081

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-37 Pomona No.2 and No.3 (Significant Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Exempt	3	3	\$996,682	\$996,682	\$1,993,364
Total	3	3	\$996,682	\$996,682	\$1,993,364

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-38 Standley Lake (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	114	311	\$288,352,339	\$288,352,339	\$576,704,678
Exempt	20	24	\$73,153,860	\$73,153,860	\$146,307,720
Multi-Family	3	562	\$157,938,265	\$78,969,133	\$236,907,398
Residential	2,886	3,251	\$1,007,425,822	\$503,712,911	\$1,511,138,733
Total	3,023	4,148	\$1,526,870,286	\$944,188,243	\$2,471,058,529

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-39 Terminal Storage Reservoir (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	5	13	\$6,709,693	\$6,709,693	\$13,419,386
Residential	622	622	\$184,911,421	\$92,455,711	\$277,367,132
Total	627	635	\$191,621,114	\$99,165,404	\$290,786,518

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Table 4-40 Woman Creek (High Hazard)

Property Type	Improved Parcel Count	Building Count	Improved Value	Estimated Content Value	Total Value
Commercial	2	2	\$224,776	\$224,776	\$449,552
Total	2	2	\$224,776	\$224,776	\$449,552

Source: Jefferson and Adams County Assessor Data 2022, DWR Dam Safety, WSP GIS Analysis

Critical Facilities

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical facilities and infrastructure. In Colorado's semi-arid environment, dams and reservoirs that supply water for municipal use can also be considered critical infrastructure themselves. Any critical assets located under the dam in an inundation area would be susceptible to the impacts of a dam failure. Of particular risk would be roads and bridges that could be vulnerable to washouts, further complicating response and recovery by cutting off impacted areas. Based on the critical facility inventory considered in the updating of this plan and intersected with the dam inundation extents available, 62 county critical facilities were found to be at risk. 32 of the facilities are categorized as transportation facilities. 13 of which are non-scour fair condition bridges and 18 non-scour good condition bridges. Mitigation activities can include elevating at risk bridges and roads above the established base flood elevation (BFE) heights. These at-risk facilities are listed below by jurisdiction and organized by Lifeline classification as based on the FEMA Lifeline categories.

Table 4-41 Critical Infrastructure and Inundation Hazard

Category	Count
Communications	5
Energy	-
Food, Water, Shelter	3
Hazardous Material	7
Health and Medical	8
Safety and Security	7

Category	Count
Transportation	32
Total	62

Source: City of Westminster, CDPHE, CEPC, HIFLD, NBI, DWR Dam Safety, WSP GIS Analysis

Economy

Extensive and long-lasting economic impacts could result from a major dam failure or inundation event, including the long-term loss of water in a reservoir, which may be critical for potable water needs. A major dam failure and loss of water from a key structure could bring about direct business and industry damages and potential indirect disruption of the local economy. A dam failure can have long lasting economic impacts and could deter visitors for a period of time.

Historical, Environmental, Cultural Resources

Dam or reservoir failure effects on the environment would be similar to those caused by flooding from other causes. Water could erode stream channels and topsoil and cover the environment with debris. For the most part the environment is resilient and would be able to rebound from whatever damages occurred, though this process could take years. However, historic and cultural resources could be affected just as housing or critical infrastructures would, were a dam to fail and cause downstream inundation that could further erode surfaces or cause scouring of structural foundations.

Development Trends

Flooding due to a water-related dam failure event is likely to exceed the special flood hazard areas regulated through local floodplain ordinances and usually mapped by FEMA’s National Flood Hazard Layer (NFHL) dataset. The city should consider dam failure and release hazards when permitting development downstream of the high hazard and significant hazard dams, in particular. Due to the phenomenon of “hazard creep,” a significant hazard dam can become rated high hazard if development occurs below it and the consequences of failure increase. Regular inspection and monitoring of dams, exercising and updating of EAPs, and rapid response to problems when detected at dams are ways to mitigate the potential impacts of these rare but potentially catastrophic events.

4.3.11 Invasive and Noxious Species

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Invasive Species	E	3	5	3	E4

Hazard/Problem Description

Invasive species are plants, animals or pathogens that are non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause harm to human, economic, or environmental health (USDA 2022). Noxious species are undesirable native organisms that attack or compete with more desirable plants and animals.

Westminster is home to a variety of local flora and fauna; however, changes in the ecosystem affect food chains and can determine the survival of these species. In Colorado, there are currently 7 amphibians, 19 birds, 23 fish, 13 mammals, 10 reptiles and 2 mollusks that are listed as threatened, endangered or a special concern by either the state or federal government (Wildlife Threatened and Endangered List 2022). Issues involving keystone species also pose an indirect hazard for local plants and animals, such as in 2015 when a plague outbreak in the prairie dog population caused birds of prey to change nesting patterns and search for other food sources (USGS).

Past Occurrences

Invasive species are either plant, animal, microbial, or aquatic (both plant and animal). Species are transplanted to new ecosystems through intentional, or unintentional, transport through a vector or due to

migratory changes brought on by climate change or loss of habitat. The Colorado Department of Parks and Wildlife lists several invasive species as either aquatic nuisance species (ANS), noxious weeds or forest pests, identified in the table below.

Table 4-42 Invasive and Noxious Species in Colorado

Aquatic Nuisance Species (ANS) are plants and animals that invade lakes, reservoirs, rivers, and streams. ANS that are top concerns for Colorado are:	Noxious weeds are terrestrial or aquatic plants that out-compete native plants for light, space and nutrients. By displacing native plants, noxious weeds eliminate necessary forage, shelter and habitat for wildlife. Top concerns for Colorado are:	Forest pests include beetles, fungi, and pathogens that threaten millions of trees. Most of these pests arrive in wood pallets or crates and are spread locally by firewood. These pests can destroy entire populations of trees. Primary concerns in Colorado are:
Zebra mussel	Meadow Knapweed	Emerald Ash Borer
Quagga mussel	Purple Loosestrife	Gypsy Moth
New Zealand mudsnail	Yellow Starthistle	Japanese Beetle
Asian carp		
Rusty crayfish		
Eurasian watermilfoil		
Viral hemorrhagic septicemia		

Source: CO Parks and Wildlife

The invasive species of greatest concern within Westminster are the Zebra Mussel and emerald ash borer. The City of Westminster services 14,000 trees in parks, greenbelts, facilities and right of ways. This is in addition to thousands of trees located in the 3,090 acres of open space within city limits. These trees are made up of species of ash, pine, spruce, honey locust, cottonwood, oak, linden, cherry, cedar, and crab apple trees. Species are interspersed throughout the city to create biodiversity and increase the resiliency of arboreal populations.

Geographical Area Affected

The geographic extent of invasive and noxious species is significant. Invasive species can spread quickly across an area when there are no predators to minimize their populations.

Emerald Ash Borer

The emerald ash borer originates in Asia and devastates ash trees. The emerald ash borer was confirmed in the City of Westminster in 2019. Nearly one in seven trees in the City of Westminster are ash trees, providing these pests with an extensive habitat to breed and spread. These pests contribute to the decline of millions of North American ash trees. Colorado State University reports that 15% of Colorado trees are ash trees and are involved in storm water mitigation, energy use, and property values. The beetle is active annually from May through July. Trees die within two to four years after an infestation begins, although signs of an infestation may take up to four years to manifest. The beetle typically travels up to a half-mile when infesting new trees, but distribution can expand dramatically through industrial wood processing.

Figure 4-33 Emerald Ash Borer

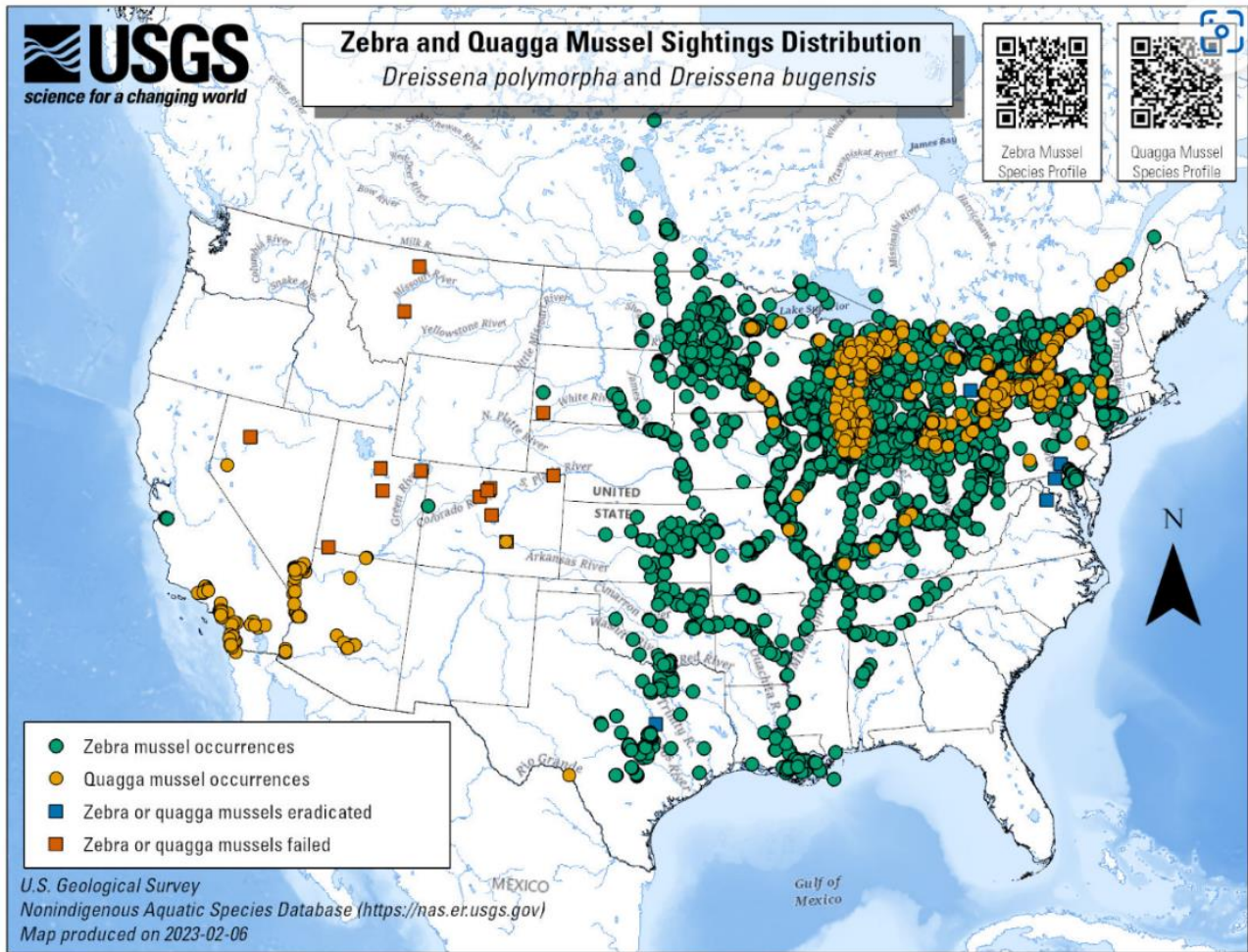


Source: Colorado State University

Zebra and Quagga Mussels

Zebra mussels are native to Central Asia and Eastern Europe. They were discovered in the Great Lakes in 1988 and have spread to 33 states. Quagga mussels are native to Ukraine. They were discovered in the Great Lakes in 1989 and have since spread to 27 states. Colorado Parks and Wildlife reported that Granby Reservoir, Grand Lake, Shadow Mountain Reservoir, Willow Creek Reservoir, Tarryall Reservoir and Jumbo Reservoir all tested positive for one zebra or quagga mussel veliger in 2008 but are now considered negative after no further detections. Highline Lake is the only known body of water in Colorado to be infested with zebra mussels. The lake tested positive for adult zebra mussels in September of 2022 and is now classified as “infested”. There are no known populations of quagga mussels in the state. Zebra and quagga mussels spread quickly, are difficult to eradicate and pose a serious clogging danger to water infrastructures.

Figure 4-34 Observed Zebra and Quagga Mussels in the United States



Source: USGS, <https://cpw.state.co.us/aboutus/Pages/ISP-Zebra-Quagga.aspx>

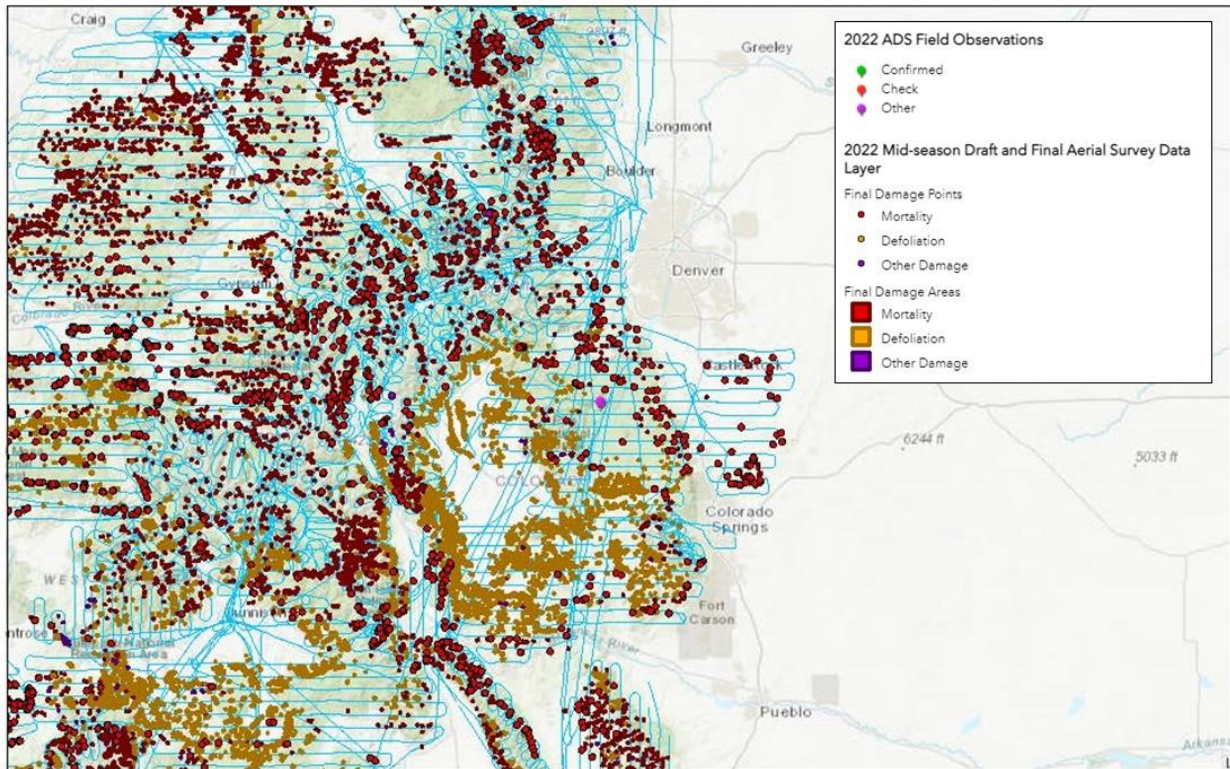
Noxious species are organisms that are native that out-compete or attack other more desirable species. Our noxious species of greatest concern include the various beetles that are attacking our forests. Various pine and spruce beetles are native to Colorado and since the latest outbreak in 1996, beetle infestations have spread to approximately 6.6 million acres of Colorado. The beetles have reached epidemic levels and will continue to affect the ecology of Colorado for decades to come; however, the impacts of large, simultaneous infestations in multiple forest systems are currently being studied, have yet to be documented and are not fully understood. There is no effective means of controlling large beetle outbreaks.

The predominant tree species in the State of Colorado are bristlecone pine, Colorado blue spruce, Douglas fir, Engelmann spruce, limber pine, lodgepole pine, narrow leaf cottonwood, quaking aspen, piñon pine, plains cottonwood, ponderosa pine, Rocky Mountain juniper, subalpine fir, and white fir. (Wildlife, Colorado Parks and Wildlife-Top Invasive Species Concerns 2018)

While beetle infestations are not a great concern within the city limits, the potential environmental degradation these insects pose to the watersheds that provide the water supply is a great concern for the city. Drought stressed trees are more susceptible to both wildfire and beetle infestation. Individually and in combination, drought, beetle infestation and wildfire pose a major threat to the water supply of Westminster and the other communities of the Front Range. The image below displays data from the

USDA Forest Service Rocky Mountain Region Forest Health Protection, indicating the extent of tree damage west of the City of Westminster.

Figure 4-35 2022 Aerial Tree Detection Survey



Source: USDA Forest Service 2022,
<https://usfs.maps.arcgis.com/apps/webappviewer/index.html?id=64880247bd374f939a42ac38589df5c9>

Magnitude/Severity

The severity of invasive and noxious species is critical. These species can degrade natural resources by competing with native plants and animal species. They can also destroy the habitats that these native animals live in. Watersheds and water supply can also be impacted by invasive species. Invasive species can also damage property. Zebra mussels have been known to cause damage to boat engines and waterpipes, and pests like the emerald ash borer can cause significant damages to landscape.

Frequency/Likelihood of Occurrence

Invasive species are likely to continue to persist in the City of Westminster. Invasive species can be extremely difficult to eradicate. In many circumstances, invasive species grow quickly and aggressively, and typically lack natural predators in the areas that they inhabit. The emerald ash borer has infested the city since 2019, and a majority of the tree kills occur within the first four to eight years of infestation. However, the city has taken measures to mitigate the spread of invasive species. The city is updating the landscape code to address the spread of Emerald Ash Borer and Standley Lake attempts to minimize the spread of aquatic invasive species by mandating that boats spray down before and after entering the lake and by limiting boat access.

Climate Change Considerations

The USGS reports that climate change has an impact on every aspect of biological invasions. Warming temperatures and changing precipitation patterns due to climate change can allow some types of invasive

species to expand their range into habitats that were previously too cool or not suitable. The USDA notes that this relationship between changing climate and invasive species is one of the top causes of global biodiversity loss. Climate change, environmental degradation, and global trade/transportation individually and in combination raise the possibility that other invasive and noxious species may be introduced into our local environment.

Vulnerability Summary

Invasive and noxious species are a persistent threat to our natural habitat, our designed landscapes and green spaces, our native species, our critical infrastructure, and our water supply. These species are an ongoing and persistent natural hazard that has the potential to have profound long-term effects on our environment, critical infrastructure, economy, and the community.

People

One of the most dangerous impacts of invasive species on humans is their potential to carry diseases. While the emerald ash borer is not known to be a host for disease, it is possible that future invasive species could carry new disease to the area. Additionally, ecosystems that are altered by the introduction of an invasive species could be less able to provide the important ecosystem services that supports human activity. For example, pests such as zebra mussels that reduce water quality and diversity of aquatic species directly impacts the community that depends on the water supply.

Property

Invasive species can cause damage to property. Small zebra mussels can damage boats by clogging equipment in the engines. Larger zebra mussels have been known to damage water pipes. While zebra mussels have not yet been reported in the City of Westminster, there have been confirmed populations of these mussels in the State of Colorado. Preventing the spread of these species depends on effective biosecurity measures and rigorous inspections of all recreational craft using our local reservoirs.

Critical Facilities

Critical facilities can be impacted by invasive species, particularly zebra mussels. Many critical facilities, such as power plants, water treatment plants, and factories have water intake pipes. These pipes can become completely blocked when zebra mussels colonize the edge of these pipes, preventing the necessary flow of water to these facilities.

Economy

The Colorado Parks and Wildlife Services reported that in the United States, ecological damage and control of invasive species cost \$200 billion per year and these costs are increasing. Direct economic impacts can include the management costs of mitigating invasive spread, either through chemical, biological, or physical means. Additional losses can be incurred from monitoring programs, reduced ecotourism, loss of natural biodiversity, and damage to infrastructure. The USGS reports that power plants and other critical infrastructure can spend millions to remove zebra mussels from water intake valves.

Historical, Environmental, Cultural Resources

Invasive and noxious species can significantly alter and damage environmental resources in the City of Westminster. The emerald ash borer can exterminate large populations of Ash trees, which can affect the natural tree composition in a forest or urban area and impact the natural forest succession. This results in habitats being more vulnerable to invasive types of exotic plant species. Similarly, zebra mussels can drastically alter the native composition of aquatic species in a lake, river, or stream. These mussels filter out algae that many native species depend on for food, resulting in reduced populations of native species.

Development Trends

New development may encourage the spread of invasive and noxious species. Invasive species can migrate through human activities such as shipments and pet trading. The globalization of trade has allowed new pathways for these invasive species to spread to foreign environments.

4.3.12 Severe Summer Storms (Including Hail & Lightning)

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Severe Summer Storm	E	4	1	4	E4
Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Hail	E	5	1	3	E4
Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Lightning	E	1	1	2	E2

Hazard/Problem Description

Severe summer storms in Westminster are most often in the form of thunderstorms, which are generally characterized by heavy rain, often accompanied by strong winds and sometimes lightning and hail. Thunderstorms affect relatively small areas when compared with the size of typical winter storms; however, they would still typically impact most or all of the city of Westminster in a single event, with local variations in the severity of impacts. Despite their small size, all thunderstorms are dangerous. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. According to the National Weather Service, a thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 57.5 mph, or a tornado. Every thunderstorm needs three basic components: (1) moisture to form clouds and rain, (2) unstable air which is warm air that rises rapidly, and (3) lift, which is a cold or warm front capable of lifting air to help form thunderstorms. This chapter profiles several sub-hazards that can impact the city in different ways – high winds, hail, and lightning.

Thunderstorms are a typical feature of the city’s weather from late May through early September. The wettest month on record was September 2013 when 6.47 inches of rain fell in the local area and neighboring communities (Boulder and Aurora/Denver) received over 8 inches of rain which caused major flooding.

Local observations and experience have established anecdotal benchmarks for severe summer storms based on the intensity and total amounts of rainfall. An intense event is anything >2 inches in 1-hour. An event of this intensity produces fast water in drainage structures and waterways as well as street flooding. A major rainfall event is anything >5 inches in 24-hours. In addition to the impacts associated with intense rain events, this amount of rainfall can cause our reservoirs to spill and produce flooding in our 100-year flood plain.

Hail

Hail is described as showery precipitation in the form of irregular pellets or balls of ice. Formation of hail occurs inside a thunderstorm where there are strong updrafts of warm air and downdrafts of cold air. If a water droplet is picked up by the updrafts, it can be carried high enough to where temperatures fall below 32 degrees where it freezes. As the frozen droplet begins to fall as it is carried by cold downdrafts, it may thaw as it moves into warmer air toward the bottom of the thunderstorm. The half-frozen droplet may get picked up again by another updraft where it is carried back into very cold air and refrozen. With each trip above and below the freezing level the frozen droplet adds another layer of ice. The frozen droplet eventually falls to the ground as hail which can reach speeds up to 120 MPH. Research has shown that damage occurs after hail reaches around one inch in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from the National Weather Service (NWS).

Colorado's Front Range is located in the heart of "Hail Alley" which receives the highest frequency of large hail in North America and most of the world. Residents can usually count on three to four catastrophic (defined as at least \$25 million insured damage) hailstorms every year. The 2017 hailstorm, described in further detail under Previous Occurrences below, was the costliest insured disaster in Colorado history and the second costliest nationwide. According to the 2018 State Hazard Mitigation Plan, the damaging hail season in Colorado ranges from mid-April to mid-August. According to an April 2020 report from the National Insurance Crime Bureau (NICB), Colorado had the second highest number of insurance claims involving hail from 2017-2019. The Rocky Mountain Insurance Information Association (RMIIA) reports that hailstorms have caused upwards of \$5 billion in damage over the last 10 years.

Lightning

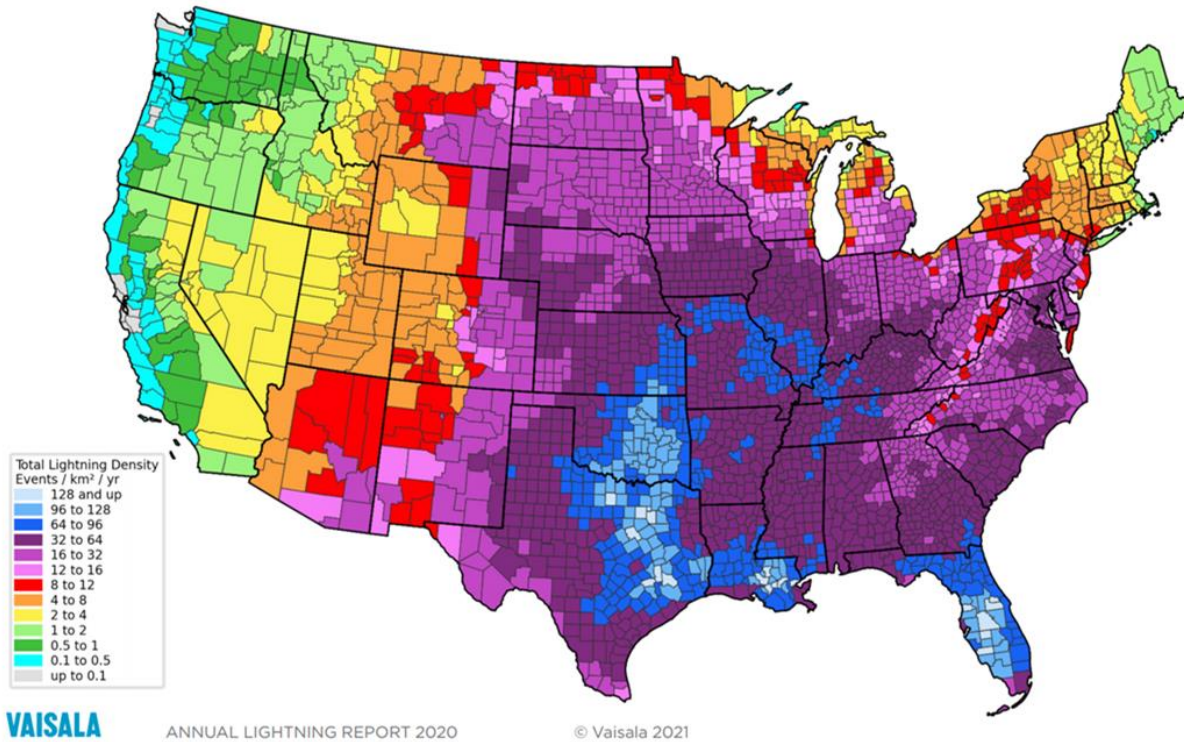
Lightning is a luminous, electrical discharge in the atmosphere caused by the electric charge separation of precipitation particles within a cumulonimbus (thunderstorm) cloud. Thunder is the resulting sound wave caused by the sudden expansion of air heated by a lightning discharge.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually, it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel can be visible for many miles.

Although not as common, cloud-to-ground lightning is the most damaging and dangerous form of lightning. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm to storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth. Using a network of lightning detection systems, NOAA monitors a yearly average of 25 million strokes of lightning from the cloud-to-ground. Figure 4-35 shows the lightning flash density for the nation. The planning area experiences 12-16 lightning events per square kilometer per year.

Figure 4-36 Average US Total Lightning Density per County, 2015-2019



According to the Vaisala Annual Lightning Report 2020, data from the National Lightning Detection Network ranks Colorado 24th in the nation with respect to the number of cloud-to-ground strokes plus cloud pulses, with a total number of 2,401,750 counts in 2020. US lightning statistics compiled by NOAA between 1959 and 1994 indicate that most lightning incidents occur during the summer months of June, July, and August, and during the afternoon hours between 2 p.m. and 6 p.m. In Colorado, it is common for afternoon thunderstorms during the summer months to occur with lightning strikes at the higher elevations.

Based on data between 1959 and 2017 from the National Weather Service, the state of Colorado ranks 32nd in terms of its cloud-to-ground lightning flash densities but ranks fourth for the number of deaths at 148. Florida (498), Texas (226), and North Carolina (200) were ranked higher. Since 1980 an average of three people are killed and 12 are injured in Colorado annually (NWS).

Past Occurrences

Between 1986 and April 2023 there were a total of 1,031 watches and warnings issued by the National Weather Service in Adams County for severe thunderstorms, summarized in Table 4.42 below.

Table 4-43 Number of Severe Thunderstorms, Watches and Warnings 1986-April 2023

Type	Count
Watch	119
Warning	912
Total	1,031

Source: National Weather Service, Iowa Environmental Mesonet

The NCEI Storm Events Database noted 8 hail events in Adams County which specifically impacted the City of Westminster since 1995. This only includes hail events which included hailstones .75" in diameter or greater. The following table summarizes some of the largest hail events in Colorado. Most of these events did not impact the City of Westminster, however these events provide an example of the possible magnitude that could occur in the planning area.

Table 4-44 Past Hail Occurrences in Colorado

Date	Location	Cost When Occurred (Millions)	2021 Dollars (Millions)*
May 8, 2017	Denver Metro	\$2.3 Billion	\$2.5 Billion
July 20, 2009	Denver Metro	\$767.6	\$955
July 11, 1990	Denver Metro	\$625.0	\$1.27 Billion
June 6-15, 2009	Denver Metro	\$353.3	\$439
July 28, 2016	Colorado Springs	\$352.8	\$392
June 6-7, 2012	CO Front Range	\$321.1	\$373
June 13-14, 1984	Denver Metro	\$276.7	\$655
June 18-19, 2018	North Denver and Denver Metro	\$276.4	\$293
July 29, 2009	Pueblo	\$232.8	\$289
October 1, 1994	Denver Metro	\$225.0	\$405
September 29, 2014	Denver Metro	\$213.3	\$240
May 22, 2008	Windsor	\$193.5	\$240

Source: Rocky Mountain Insurance Information Association

*2021 estimated cost calculations based on the Consumer Price Index

Lightning is a common occurrence in Westminster, as every single thunderstorm produces lightning. However, most lightning strikes go unreported unless they cause significant damage or injuries. The NCEI Storm Events Database and the NWS list 5 events occurred in the Westminster between 2001 and 2010 (note, no events were found in either database after 2010) that were reported as causing casualties or significant damages.

Geographical Area Affected

The entire planning area is exposed to the same level of risk for severe summer storms and is prone to their occurrence in summer months. As mentioned above, thunderstorms are typically a large enough size that they would still impact most or all of the city of Westminster in a single event, with local variations in the severity of impacts.

Magnitude/Severity

Severe summer storms are capable of producing damaging hail and lightning, as well as high winds, tornadoes, heavy precipitation, and flash flooding which can all cause damage. The National Weather Service has developed a scale and metrics for classifying the severity of thunderstorms which provides a method of describing the magnitude and severity of this hazard. The following describes how severe thunderstorm watches and warnings are defined by the National Weather Service.

- **Severe Thunderstorm Watch:** Issued when severe thunderstorms are possible in and near the watch area. It does not mean that they will occur. It only means they are possible. Severe thunderstorms are defined as follows:
 - Winds of 58 mph or higher
 - AND/OR
 - Hail one inch in diameter or larger.
- **Severe Thunderstorm Warning:** Issued when severe thunderstorms are occurring or imminent in the warning area. Severe thunderstorms are defined as follows:

- Winds of 58 mph or higher
AND/OR
- Hail one inch in diameter or larger.

Hail

Severe hailstorms can be quite destructive to property and crops. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans and occasionally has been fatal.

Colorado’s severe hail season is between mid-April to mid-September and an average of 119 days per year (NICB 2020).

The National Weather Service (NWS) classifies hail by diameter size and corresponding everyday objects to help relay scope and severity to the population. Table 4.44 indicates the hailstone measurements utilized by the NWS.

There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground. Multi-cell thunderstorms produce many hailstones, but not usually the largest hailstones. In the life cycle of the multi-cell thunderstorm, the mature stage is relatively short so there is not much time for growth of the hailstone. Supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud. In general, hail two inches (5 cm) or larger in diameter is associated with supercells (a little larger than golf ball size which the NWS considers to be 1.75 inch.). Non-supercell storms are capable of producing golf ball size hail.

The largest hailstone recorded in Adams County in the NCEI database had a diameter of 4.5 inches on July 13, 2011. The most recorded hailstone size is one inch. Table 4-41 indicates the hailstone measurements utilized by the National Weather Service.

Table 4-45 Hailstone Measurements

Severity	Description	Hail Diameter Size (in inches)
<p style="text-align: center;">Non-Severe Hail</p> <p>Does not typically cause damage and does not warrant severe thunderstorm warning from NWS.</p>	Pea	1/4"
	Marble/mothball	1/2"
	Penny	3/4"
	Nickel	7/8"
<p style="text-align: center;">Severe Hail</p> <p>Research has shown that damage occurs after hail reaches around one inch in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from NWS.</p>	Quarter	1" (severe)
	Half Dollar	1 1/4"
	Walnut/Ping Pong Ball	1 1/2"
	Golf Ball	1 3/4"
	Hen Egg	2"
	Tennis Ball	2 1/2"
	Baseball	2 3/4"
	Teacup	3"
Grapefruit	4"	

Source: National Weather Service

Lightning

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into specific categories. It is a common parameter that is part of fire weather forecasts nationwide. The planning area is at risk to experience lightning in any of these categories. The LAL is reproduced in Table 4.45.

Table 4-46 Lightning Activity Level Scale

Lightning Activity Level	
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud-to-ground strikes in a five-minute period
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud-to-ground strikes in a five-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud-to-ground strikes in a five-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud-to-ground strikes in a five-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning.

Source: National Weather Service

Frequency/Likelihood of Occurrence

Severe thunderstorms are an annual occurrence throughout the Front Range and can be expected to occur multiple times in the City of Westminster every year. Atmospheric convection activity producing conditions prone to hail are expected to occur in similar frequency and extent in the future as in the past. Based on the record of past occurrences, there is a likelihood for future occurrences of approximately 3 severe thunderstorm watches and approximately 25 severe thunderstorm warnings in Adams County per year.

Climate Change Considerations

As the atmosphere warms further due to climate change, the increased heat in the atmosphere provides more energy that drives severe storms. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate. The changing water cycle caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

Warmer temperatures are also likely to impact the strength of updrafts leading to the development of storms that can create larger hailstones. In lower-lying areas, warmer temperatures may help to melt hailstones before they can cause damage. However, in Adams County and the rest of the Front Range, the combination of high altitude and dry air makes it more likely that hailstorms will increase in size and impact as average global surface temperatures continue to climb. Rates of lightning occurrence are also likely to be impacted by climate change. According to Colin Price, author of *Thunderstorms, Lightning and Climate Change*, "The distribution of lightning around the planet is directly linked to the Earth's climate." In his book, Price identifies that climate change is likely to increase the number of intense thunderstorms which will lead to an "increase in the amount of lightning by 10% for every one-degree global warming." Scientists have started to document changes in lightning frequency as the climate changes. As average global surface temperatures increase, it is likely that there will be more intense thunderstorms, more frequent lightning strikes, and more wildfires ignited by lightning strikes.

VULNERABILITY SUMMARY

People

People are vulnerable to the direct impacts of severe summer weather in many ways. They can be struck by flying debris, be caught in building collapses, face danger while engaging in outdoor activities, and be caught by flash floods. The highest risk demographic is first responders who are dealing with emergency situations resulting from the storm. Those working or recreating outdoors can be susceptible to injury from wind borne debris, hail, and lightning strikes.

Some segments of the population are especially vulnerable to the indirect impacts of severe thunderstorms, particularly the loss of electrical power. As a group, the elderly or disabled, especially those with home health care services, rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes or other special needs housing may also be vulnerable if electrical outages are prolonged. In Adams County, 12.4% of Medicare Beneficiaries (7,707 of 62,307 total beneficiaries) rely on electricity to live independently in their homes, respectively. Power outages can be life-threatening to those dependent on electricity for life support.

Property

Severe thunderstorms can have a high impact on the entire planning area, with hail having perhaps the greatest economic impact of the three sub-hazards. Hail impacts anything exposed to the event, including structures, infrastructure, landscaping, personal property and vehicles. Hail is also the costliest insured-losses natural disaster to impact the state of Colorado, with nine separate incidents falling within the 'top ten disasters' list for the state. The event of record for hail occurred in May 2017, with \$2.5 billion in damages, and is considered the second costliest hailstorm in US history. Additionally, both lightning and high winds have the potential to damage existing infrastructure.

Existing development remains exposed to severe thunderstorms with minimal mitigation opportunities. Vehicles can be parked under shelters to help minimize damage costs incurred in that arena. However, in many cases it is impossible to move existing development away from the impact areas. For example, hail heavily impacts the economic contributors who house merchandise outdoors, such as car retailers, home improvement stores and gardening stores. Damage to landscape is also almost impossible to prevent, as the plants cannot be transported indoors for the storm.

Critical Facilities

Transportation infrastructure can be affected by hail, heavy rain, and lightning events, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads. Of particular concern are roads providing access to isolated areas and the elderly, especially given that limited local roads and highways are available to move people and supplies throughout the region. Prolonged obstruction of major routes due to landslides, debris, or floodwaters can disrupt the shipment of goods and other commerce.

Severe windstorms and downed trees can create serious impacts on power and above-ground communication lines. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Lightning events can have similarly destructive effects on power and information systems. Failure of these systems would have cascading effects throughout the cities and could disrupt critical facility functions. Downed power lines can cause blackouts, leaving large areas isolated.

Economy

Typically, severe thunderstorms by themselves do not cause major, long-term economic impacts. Lightning, high winds and hail can all cause property damage, though much of this is insured loss; an example is car lots, where entire inventories can be significantly damaged in a matter of minutes. Lightning and high winds can cause localized power loss, though this is usually short-term. Generally, long-term economic impacts center more around hazards that cascade from a severe thunderstorm.

Historical, Environmental, Cultural Resources

Severe summer storms are a natural environmental process. Environmental impacts include the sparking of potentially destructive fires by lightning and localized flattening of plants by hail. High winds can have many impacts on the environment, including erosion and, flattening of trees and plants. Winds can cause wildfire to spread at a faster rate and exacerbate the impacts of winter storms and severe cold. As a natural process, the impacts of most severe thunderstorms are part of the overall natural cycle and do not cause long-term consequential damage.

Development Trends

New critical facilities such as communication towers should be built to withstand heavy rain damage. Future development projects should consider severe weather hazards at the planning, engineering, and architectural design stages to reduce vulnerability. Development trends in Westminster are not expected to increase overall vulnerability to the hazard but all development will be exposed to severe summer storm events.

Meanwhile, continued development implies continued population growth, which raises the number of individuals potentially exposed to severe weather. Individual citizens, families, and businesses need to be prepared to address severe weather events when they occur. In addition, public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of severe weather.

4.3.13 Severe Winter Storms/Blizzards

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Severe Winter Storm	E	5	2	2	E3

Hazard/Problem Description

Severe winter storms include events related to heavy snow, blowing snow, ice, sleet or freezing rain, and extreme cold temperatures (including wind chill). Blizzards are severe winter storms that pack a combination of blowing snow and wind resulting in very low visibilities. Sometimes strong winds pick up snow that has already fallen, creating a ground blizzard. Hazardous winter weather may also result from bitterly cold temperatures and may not involve snow. The NWS generally categorizes winter storms into the following:

- Winter Storm: indicates heavy snow or significant ice accumulations.
- Blizzard: A blizzard means that the following conditions are expected to prevail for a period of three hours or longer: Sustained wind or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than ¼ mile).
- Ice Storm: An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater.
- Winter storms occur frequently and can have significant impacts, especially on Westminster's vulnerable populations, first responders, and critical infrastructure.

Winter storms may occur during fall, winter, and spring on Colorado's eastern high plains. While Westminster area blizzards are less frequent and drop less snow than in areas further east and north, they can still be devastating. The March 2003 blizzard that impacted both Adams and Jefferson Counties resulted in \$31 million in property damage and two injuries.

Past Occurrences

Winter storms and heavy snow hazards are not uncommon since 1996, based on the NCEI database. There have been 890 reports of blizzard, cold/wind chill, extreme cold/winter chill, heavy snow, ice storm, winter storm and winter weather events that caused around \$49.6 million in property loss in combination with 1 death and two injuries in Adams and Jefferson Counties. It is assumed that these winter weather events across Adams and Jefferson Counties are likely to have also affected the City of Westminster at some point or to some extent.

Past significant winter weather events that impacted Westminster include but are not limited to:

- December 21-26, 2022, a “bomb cyclone” resulted in life-threatening cold temperatures and the coldest day on record in the past 30 years. More frequent extreme winter storms are linked to warmer surface temperatures in the Arctic. These warmer temperatures result in a less stable polar vortex which can slip to lower latitudes and produce rapid, drastic drops in pressure and temperature and extreme winds. These events have become more common in the past five years.
- March 13, 2019, the lowest pressure ever recorded in Colorado occurred resulting in a “bomb cyclone” in which barometric pressure dropped in excess of 24 mb over a 24-hour period. This resulted in wind gusts from 60 to 80 mph, up to 100 mph and blizzard conditions across our area. Transportation was significantly disrupted, and 445,000 customers lost power across the Front Range and plains. Locally, schools, businesses and government offices were closed for 1-2 days. https://www.weather.gov/pub/Bombogenesis_20190313
- October 29-30, 2019: snowstorm with 8 inches of snow deposited in Westminster; one fatal car accident was attributed to the weather.
- March 2003: largest snowstorm since 1946 with 31.8 inches of snow.
- April 11, 2001: Blizzard/snowstorm with 9 inches of snow deposited in Westminster; this event resulted in \$3.1 million of property damage in the Denver metropolitan area.

The Rocky Mountain Insurance Information Association (RMIIA) estimates the blizzard of March 2003 was the most expensive winter storm from snow and ice damage in Colorado history, costing \$93.3 million in insured damages (\$110.6 million in 2010 dollars). RMIIA reports that the majority of 2003 blizzard damage was the result of wet, heavy snow that collapsed roofs, porches, awnings, carports and outbuildings. There was also significant damage from downed trees and limbs, along with claims for wind, snowmelt leakage, food spoilage and out-of-pocket living expenses for people forced out of their homes due to storm damage. Most of the vehicle damage was due to being crushed rather than weather-related accidents. For the 2003 storms, the average cost per homeowner insurance claim was more than \$3,500 and many homes were completely destroyed due to roof collapses and structural damage.

Geographical Area Affected

Any area of Westminster is susceptible to the impacts of a severe winter storm.

Magnitude/Severity

The NWS typically alerts Westminster to storms that will impact the City by issuing Winter Storm Warnings, Wind Chill Warnings or Blizzard Warnings. The NWS in Boulder issues a Winter Storm Warning when conditions that can quickly become life-threatening and are more serious than an inconvenience are imminent or already occurring.

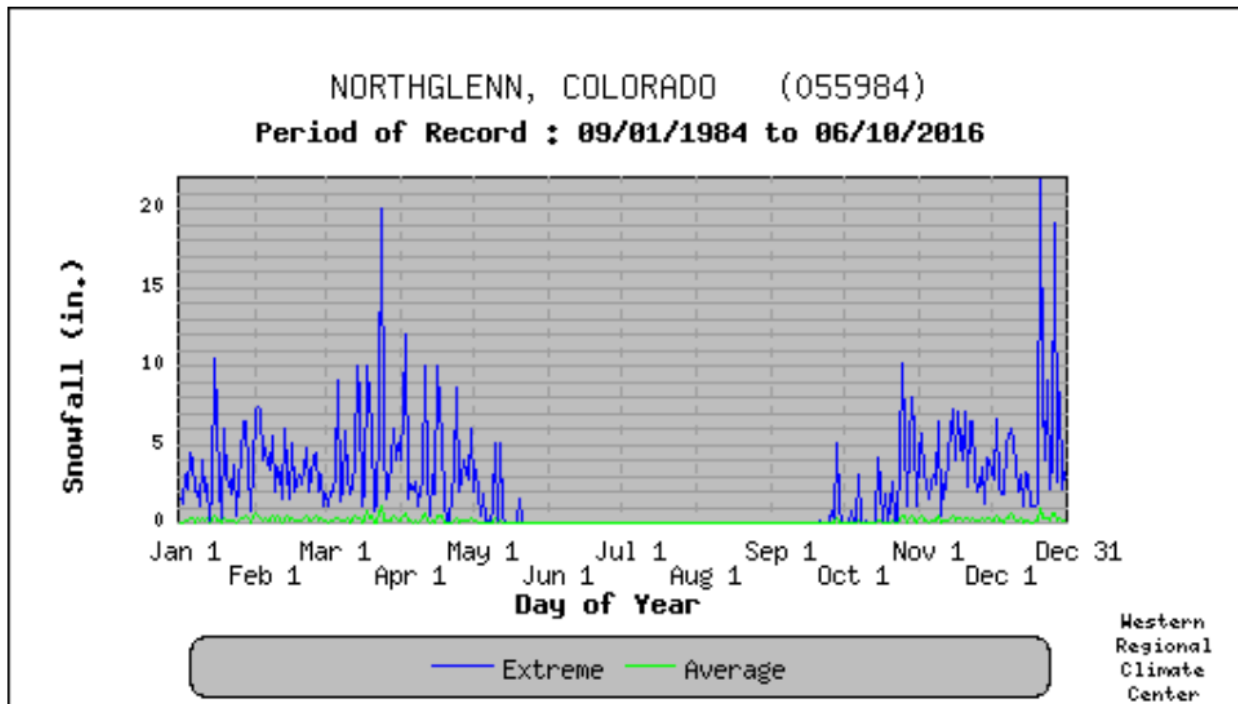
Heavy snows, or a combination of snow, freezing rain or extreme wind chill due to strong wind, may bring widespread or lengthy road closures and hazardous travel conditions, plus threaten temporary loss of community services such as power and water. Deep snow and additional strong wind chill or frostbite may be a threat to even the appropriately dressed individual or the strongest person exposed to the frigid weather for only a short period.

A Wind Chill Warning is issued when the wind chill temperatures are at or colder than minus 50 degrees Fahrenheit. At this level, frostbite can occur on exposed flesh within minutes. As the wind chill temperature drops, the frostbite time decreases, especially with higher wind speeds.

The most dangerous of all winter storms is the blizzard. A blizzard warning is issued when winds of 35 miles an hour will occur in combination with considerable falling and/or blowing snow for at least three hours. Visibilities will frequently be reduced to less than 1/4 mile and temperatures are usually 20 degrees Fahrenheit or lower.

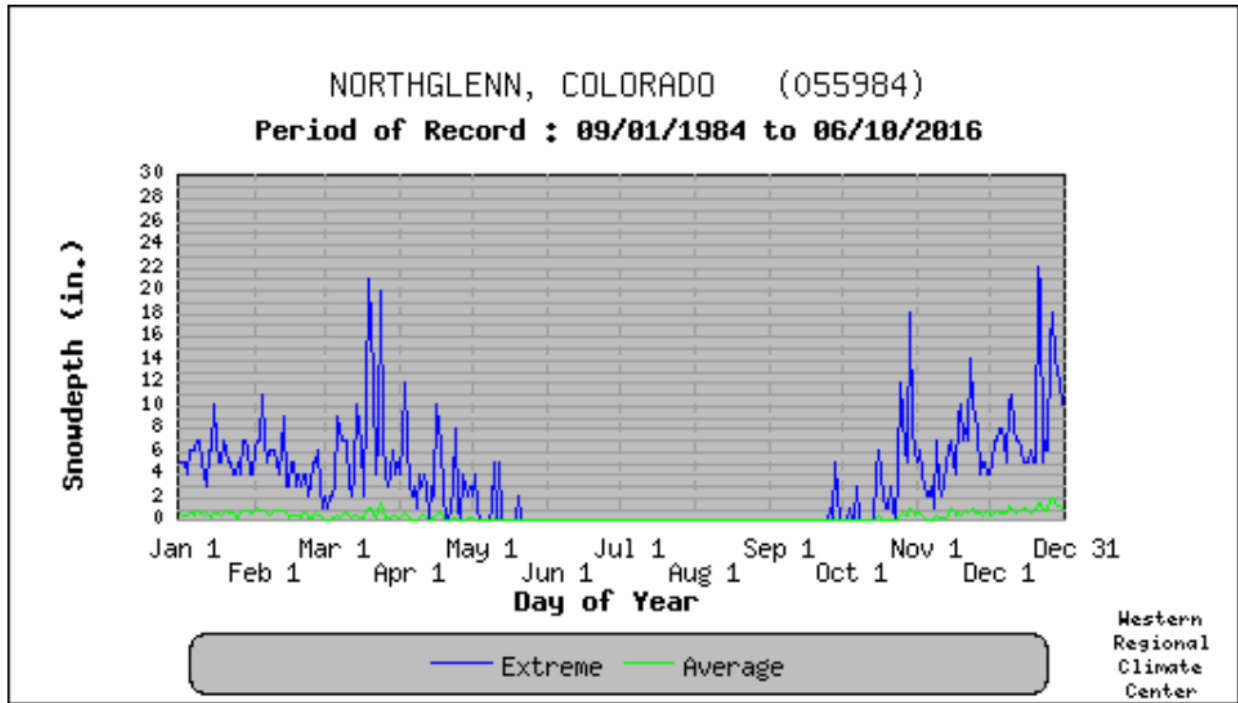
Based on Western Regional Climate Center data, between the period from 1984 to February 2023 and based on the sum of monthly averages, the closest weather station to the City of Westminster – Northglenn, received an annual average of 45.9 inches of snow per year, with a maximum annual snowfall amount of 79.5 inches in from late 2015 to early 2016, the most snowfall in a single month occurred in March 2016, with 33.4 inches falling. Figure 4-36 shows the daily snowfall average and extreme at the Northglenn station from September 1, 1984 to June 10, 2016. Figure 4-40 shows the daily snow depth average and extreme at the Northglenn station for the same period.

Figure 4-37 Northglenn Daily Snowfall Average and Extreme, 1984-2016



Source: Western Regional Climate Center

Figure 4-38 Northglenn Daily Snow Depth Average and Extreme, 1984-2016



Source: Western Regional Climate Center

Frequency/Likelihood of Occurrence

Atmospheric activity producing conditions prone to winter weather such as ice, snow, extreme cold, and high winds are expected to continue to occur. Westminster is at risk from severe winter weather effects including cold temperatures, ice, heavy snow, and high winds on an annual basis.

Climate Change Considerations

According to recent findings published by Environmental Defense Fund (EDF), more periodic and high-intensity snowfall and rain events during winter storms is an expected outcome of climate change, because a warmer planet is evaporating more water into the atmosphere. The added moisture means more precipitation in the form of heavy snowfall or precipitation in the form of rain rather than snow due to warmer temperatures. Moreover, climate change may be expected to lead to more frequent extreme weather conditions in the future. A recent article published on Union of Concerned Scientists on February 1, 2023 also agrees with EDF's conclusion. More evaporation provides more moisture for storms, resulting in more frequent heavy precipitation events, which in turn increases the intensity of the impacts of winter storms.

Vulnerability Summary

Severe winter storms and blizzards are unpredictable annual events that impact the entire region. The primary concerns are travelers and commuters who may be stranded on our roads, snow removal, disruption of electrical service, collapsed roofs, downed power lines and poles and broken tree branches. Severe winter storms and blizzards have the potential to strand or displace residents and travelers, disrupt critical infrastructure, business and city operations.

People

Winter storms, and heavy snow and high winds are similar. The combination of heavy snow and strong winds can easily knock out the City's power supply. Interruption of power causes people to lose electricity, which affects the heating of homes and water, pumping of water, refrigeration, lighting, computing, as well as the loss of communication systems like television and the internet. Power outages can be life-threatening to those dependent on electricity for life support.

Downed trees and fallen power lines might occur, posing a fire and/or electrocution threat and can result in fatalities and injuries. Moreover, transportation around the City can be affected, with road closures interrupting movement. Productivity is also lost due to the increased time it takes to go from one point to another. When roads are closed for avalanche prevention or snow removal, drivers who must wait by the roadside are put at an increased risk because of being stranded enroute. Stranded commuters may also be vulnerable to carbon monoxide poisoning or hypothermia.

In addition, vulnerable populations including the elderly, low-income and/or linguistically isolated populations can face worse isolation and exposure during severe winter weather events and also face secondary effects of the hazards. Additionally, individuals engaged in outdoor recreation during a severe winter event may be difficult to locate and rescue.

Property

Property vulnerabilities to severe winter storms include damage caused by extreme cold temperatures, high winds, ice, snowpack, and subsequently melting snow. Vehicles may be damaged by the same factors, or temporarily unusable due to the driving conditions created by severe winter weather. Contents of homes, storage units, warehouses and storefronts may be damaged if the structures are compromised or fail due to the weather, or during potential flooding caused by melting snow.

Exposed infrastructure and utilities are impacted by both accumulated snow and winds; a typical example is power lines brought down by a combination of snowpack and wind, thus causing energy outages, as mentioned previously. Additionally, severe cold can cause a spike in utilities necessary for heating and warmth. Extreme cold can freeze water pipes that are either exposed, buried at a shallow depth, or located in poorly insulated buildings, causing pipe breaks and flooding.

The density of very wet snowpack may create strains on structures, causing partial or entire collapses of walls, roofs, or windows; Vulnerability to snow loading is influenced by architecture (flat roofs being more vulnerable), age and type of construction material, and should be assessed on a building-by-building basis. Moreover, a frequently overlooked impact of accumulated snow is buried fire hydrants, which could impede fire response if a hydrant needs to be dug out before use.

Critical Facilities

Due to the unpredictability of severe winter storm strength and path, most critical infrastructure that is above ground is equally exposed to the storm's impacts. Roads are especially susceptible to the effects of a winter storm, and can impact access to critical services and sites, impairing functionality. Tertiary impacts from winter storms, such as snow and ice damage to electrical systems, or damage from tree limbs falling on power lines, can cause disruptions in electrical service and impact critical infrastructure sector functionality. Critical infrastructure assets can be damaged by the accumulation of snow and ice.

Economy

Due to electrical power outages and interruption of power caused by winter storms, heavy snow and high winds, businesses lose the use of cash registers, gasoline pumps and restaurant kitchen appliances, leading to potential operational threats to industries including commerce, tourism, and recreation industries. Economic impacts primarily stem from snow removal and restoration activities. Other direct costs affect primarily the financial and insurance category from property damage. Disruptions to business operations resulting in short-term regional or local impacts may occur.

Some local roads in the City are not plowed or may take several days to be plowed, which can result in reduced ability for people to commute to work in addition to restricted access to first responders. While mountain road closures occur outside of the City are usually not long-term in nature, they can still have a major impact on the ability to transfer goods and services to and from the City on major routes west of the City.

As mentioned above, the RMIIA estimates the blizzard of March 2003 was the most expensive winter storm from snow and ice damage in Colorado history, costing \$93.3 million in insured damages (\$145.5 million in 2023 dollars). This could be considered the event of record. The other most costly winter events in Colorado are as follows, according to RMIIA: a 1997 snowstorm in October caused \$10.5 million in

damages, a September 1995 snowstorm caused \$6.4 million in damages and a Christmas-time storm in 1982 caused \$4.9 million in damages.

Historical, Environmental, Cultural Resources

Winter weather is part of the natural ecological cycle. According to the EPA, blizzards have the potential to cause significant damage to forests and vegetation, including mold and fungus damage from damp conditions and risk of flooding. Additionally, evaporation from accumulated snow increases the amount of water vapor in the air, potentially increasing risk for heavier rains later on. Impacts from severe winter weather could result in the death of wildlife, which may temporarily impact natural food chains. In most cases, long-term ecological impacts would be minimal.

Specifically, areas of the City that have large, old trees are more susceptible to falling trees and branches; beyond doing damage to the vegetation itself, these could also cause property damage or injury.

Development Trends

Continued development implies continued population growth, which raises the number of individuals potentially exposed to severe weather. Vulnerability to future development will be somewhat tempered by existing building codes with ground snow load and wind speed design requirements.

Due to the frequency of severe winter storms, and heavy snow and high winds, individual citizens, families, and businesses of the City need to be prepared to address severe weather events when they occur. It is recommended that citizens, families, and businesses have a plan, store extra supplies of food and water, as well as other related supplies such as flashlights, batteries, and firewood and have a battery-operated radio within their home or business. Other protective measures for both existing and future development include trimming tree limbs and securing potentially windblown possessions when not in use. Meanwhile, public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of severe weather.

4.3.14 Solar/Geomagnetic Storm

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Solar/Geomagnetic Storm	A	5	1	4	A4

Hazard/Problem Description

Definition: A major disturbance in the Earth’s magnetosphere caused by intense solar winds associated with solar coronal mass ejections (CMEs). These storms can result in intense currents and global geomagnetic disturbances that can disrupt global satellite systems and create harmful geomagnetic induced currents in the power grid and pipelines.

Description: Solar activity associated with geomagnetic events can be divided into four main components: solar flares, coronal mass ejections, high-speed solar wind, and solar energetic particles.

Solar flares affect the ionosphere immediately, with adverse effects on communications and radio navigation. Solar energetic particles reach the Earth within 20 minutes to several hours and threaten the electronics of spacecraft and any unprotected astronauts. Ejected bulk plasma and its magnetic field arrive in 30 to 72 hours, setting off a geomagnetic storm, causing currents to flow in the magnetosphere, and energizing particles. The currents cause atmospheric heating and increased drag for satellite operators; they also induce voltages and currents in long conductors at ground-level, adversely affecting pipelines and electric power grids. The energetic particles cause auroras, as well as surface and deep dielectric charging of spacecraft. The subsequent electrostatic discharge of the excess charge build-up can damage spacecraft electronics. As the ionosphere departs from its normal state, due to the currents and the energetic particles, thereby adversely affecting communications and radio navigation.

Coronal mass ejections (CMEs) are bubbles of gas and magnetic fields that are suddenly and violently released from the confined solar atmosphere, structured by strong magnetic fields in the outer solar atmosphere, known as the corona. When a large CME occurs, it can contain a billion tons of matter that is accelerated to several million miles per hour in a spectacular explosion. As a result, solar material streams out, impacting any planet or spacecraft in its path. While CMEs are sometimes associated with flares, they can also occur independently.

Solar wind is a stream of charged particles emitted by the Sun that interacts with Earth's magnetosphere, a natural shield that protects our planet and its infrastructure from the majority of solar particles. When a high-speed stream of solar radiation, like a CME occurs, the magnetosphere interacts with the oppositely oriented magnetic field of the Earth, peeling open the Earth's magnetic field. This allows energetic solar wind particles to stream down the field lines and impact the Earth's atmosphere over the poles. When these particles collide with atoms and molecules in the atmosphere, energy is released, resulting in the appearance of auroras. The result is a magnetic storm, which manifests as a rapid decrease in the Earth's magnetic field strength lasting around 6 to 12 hours, followed by a gradual recovery period of several days. Strong electrical currents along the Earth's surface during auroral events can disrupt electric power grids or cause corrosion of oil and gas pipelines.

Solar energetic particles are high-energy charged particles believed to be mainly released by shocks formed at the front of CMEs and solar flares. When a CME cloud plows through the solar wind, high-velocity solar energetic particles can be produced. Since solar energetic particles are charged, they are constrained to follow the magnetic field lines that pervade the space between the Sun and the Earth. Therefore, only the charged particles that follow magnetic field lines intersecting with the Earth will result in impacts. Solar energetic particles pose a threat to spacecraft electronics and unprotected astronauts.

In the event that a geomagnetic event occurrence should happen, FEMA's Ready.gov website states that people should:

- Follow energy conservation measures to keep the use of electricity as low as possible, which can help power companies avoid imposing rolling blackouts during periods when the power grid is compromised.
- Follow the Emergency Alert System instructions carefully.
- Disconnect electrical appliances if instructed to do so by local officials.
- Do not use the telephone unless absolutely necessary. During emergency situations, keeping lines open for emergency personnel can improve response.

Past Occurrences

There have been several recorded instances of geomagnetic events interfering with electric grids and satellites. Several such events are summarized in Table 4.46 below, followed by an in-depth review of a few of the events.

Table 4-47 Notable Geomagnetic Events

Date	Summary
September 1-2, 1859	A powerful solar storm that caused widespread disruption of telegraph systems and auroral displays visible as far south as the Caribbean.
November 17, 1882	A massive solar flare and CME that produced auroras visible as far south as Texas and disrupted telegraph systems across North America and Europe.
May 13-15, 1921	A powerful CME that disrupted telegraph and telephone systems worldwide, also affecting undersea cables, causing widespread communication outages and leading to power grid failures in some areas.
March 23-24, 1940	A severe geomagnetic storm caused by a CME that disrupted radio communications and produced auroras visible as far south as Mexico.
February 11-14, 1958	A series of CMEs which disrupted communication systems, caused power grid failures, and produced intense auroral displays visible in parts of Europe and the United States.
May 18-20, 1967	A powerful solar storm that caused a significant disturbance in the Earth's magnetic field, leading to widespread communication disruptions, including the shutdown of some

Date	Summary
	transatlantic radio communications, and auroral displays visible as far south as Mexico and Florida.
August 4, 1972	A CME which disrupted radio communication and caused power outages, and almost led to the launch of a nuclear warhead in the United States due to false readings from early warning systems.
March 13, 1989	A CME which led to a widespread power outage in Quebec, Canada, and caused disruptions in communication and navigation systems across North America.
October 29-31, 2003	Several CMEs which led to significant disruption of communication and navigation systems, power outages, and damage to satellites, making it one of the most severe solar storms recorded in modern times.

A powerful geomagnetic storm, known as the Carrington Event, occurred on **September 2, 1859**, when a CME hit the Earth's magnetosphere. Many telegraph systems across Europe and North America were disrupted or completely knocked out of service due to induced electric currents. Telegraph operators reported sparks and shocks, and in some cases, their equipment caught fire. Aurora displays were visible as far south as the Caribbean, and in some places, the auroras were so bright that they cast shadows at night. Some compasses even malfunctioned, and there were reports of unusual magnetometer readings. The event was named after the astronomer Richard Carrington, who observed the solar flare that caused the event. It is considered the largest geomagnetic storm in recorded history.

The geomagnetic storm of **May 1967** was a major solar event that occurred during the height of the Cold War. On May 23, a powerful solar flare erupted from the Sun, producing intense bursts of X-rays and radio waves. The flare was so strong that it caused radio blackouts and communication disruptions around the world, and even caused some electrical power outages. Subsequently, record-setting geomagnetic and ionospheric storms compounded the disruptions.

The August 1972 solar storms were a series of powerful geomagnetic events that were triggered by a massive solar flare that erupted from the Sun on **August 4, 1972**. The resulting CME arrived at the Earth's magnetosphere on August 5, the fastest CME transit time recorded, triggering a severe geomagnetic storm that caused widespread disruption to radio communications and power systems, causing electrical power outages in the northeastern United States and in parts of Canada. In addition to the geomagnetic storm, the event also produced a high-energy proton event that was detected by several spacecraft. The proton event caused several malfunctions in satellite and spacecraft electronics, including the loss of several high-altitude reconnaissance satellites. The dose of particles that would have hit astronauts on August 7, 1972, if there had been a mission outside of Earth's magnetic field, had the potential to be life threatening. Additionally, severe technological disruptions caused accidental detonation of numerous magnetic-influence sea mines.

On **March 13, 1989**, a severe geomagnetic storm was caused by a CME that had been released by the Sun on March 9th. When the CME arrived at the Earth, it interacted with the planet's magnetic field, causing it to fluctuate rapidly. The resulting geomagnetic storm caused a series of power outages in the Canadian province of Quebec, leaving over 6 million people without electricity for nine hours. In addition to the power outages, the storm also caused disruptions to radio communications and satellite operations. Several satellites were temporarily shut down, and some experienced permanent damage to their electronics.

Geographical Area Affected

Extensive – The entirety of Westminster is exposed to a potential solar/geomagnetic storm, which have historically occurred on a regional scale. However, the extent to which the City would be affected would also depend on the specific type and intensity of the event.

Magnitude/Severity

As our reliance on technology continues to increase on a global scale, the potential damages caused by a solar/geomagnetic event similar to the 1859 Carrington Event would be **critical**. The impacts of such an

event could include widespread electrical disruptions and blackouts, disruptions to global communication networks, and extensive damage caused by extended power outages. Specifically for the City of Westminster, the most likely secondary impacts of a geomagnetic event would be disruptions to the electric power grid, which would, in turn, affect the power supply to homes and businesses, as well as emergency public safety communications.

Frequency/Likelihood of Occurrence

Using the data provided in Table 4-47, which summarized nine significant solar/geomagnetic events that have occurred over the past 164 years, the chance of a significant event occurring during any given year is **unlikely**. The sun entered its 25th recorded 11-year cycle in December 2019. A 2020 study reported that severe solar storms capable of disrupting satellites and communication system had occurred 42 times in the last 150 years. The most extreme storms occurred six times or once every 25 years during the same period. Our next solar maximum will occur in 2025. Numerous complex factors must align to produce significant impacts on major elements of our communications and power infrastructures. The last severe solar storm event to impact Earth occurred in 1989 and caused a 9-hour outage of Quebec's power grid. Earth narrowly missed a major CME event in 2012. Solar weather observation and warning systems have improved greatly in recent years, but mitigation and planning efforts at the local level are lagging.

<https://earthsky.org/space/how-likely-space-super-storms-solar-flares-carrington-event/>

Climate Change Considerations

There are two possible ways in which climate change and geomagnetic events can interact: geomagnetic events can influence the effects of climate change, and climate change can influence the effects of geomagnetic events.

Geomagnetic events can affect climate change through gradual or sudden factors. Many of the gradual types of geomagnetic factors are linked to cloud formation. Cosmic rays can affect cloud formation by ionizing the atmosphere and influencing chemical processes (Dorman, 2009).¹² Clouds are essential to the Earth's climate system as they have a significant impact on the energy budget, water cycle, and transport of trace gases and aerosols through precipitation. Clouds cool the planet on average, and any alteration in cloud amount or distribution could thereby affect the climate.

The sudden solar factors that may affect climate change include supernova explosions and asteroid impacts, which would likely be catastrophic to our civilization. Recent observations of binary pulsars Geminga and PSR J0437–4715, and of supernova SN 1987A, strengthen the hypothesis that one or more supernova extinctions have occurred during the Phanerozoic era (Dorman, 2009). A nearby supernova explosion would result in depletion of the ozone layer, exposing both marine and terrestrial organisms to lethal solar UV radiation. Photosynthesizing organisms, such as phytoplankton and reef communities, would be especially vulnerable to such exposure.

Ways in which climate change affects the Earth's susceptibility to geomagnetic events are not well understood. However, it is likely that the effects climate change has had, and will continue to have, on the Earth's magnetic field and atmosphere will make the Earth more susceptible to geomagnetic events. Courtillot and others (2007) observed correlations between changes in climate and magnetic field variations. Such variations could weaken the protective influence of the Earth's magnetic field and make it more vulnerable to the effects of geomagnetic events.¹³ In addition, climate change also affects the composition of the Earth's atmosphere. Changes in GHG concentrations, for example, can lead to changes in temperature and circulation patterns in the atmosphere. These changes can affect the

¹² Dorman, Lev I. "The role of space weather and cosmic ray effects in climate change." In *Climate Change*, pp. 43-76. Elsevier, 2009.

¹³ Courtillot, Vincent, Yves Gallet, Jean-Louis Le Mouél, Frédéric Fluteau, and Agnès Genevey. "Are there connections between the Earth's magnetic field and climate?." *Earth and Planetary Science Letters* 253, no. 3-4 (2007): 328-339.

behavior of the ionosphere, potentially weakening the Earth's resistance to geomagnetic events (Laštovička et al., 2008).¹⁴

Vulnerability Summary

As a low probability, high impact event, this hazard has the potential to significantly damage and disrupt power and communications critical infrastructures. These disruptions could be prolonged and would cascade into other critical infrastructures (water, emergency operations, government, business, transportation etc.) that are dependent on reliable power, satellite communications, and GPS. These disruptions have the potential to endanger lives and cause significant economic losses and damage to the environment.

People

While research of the effects of geomagnetic events to human health is a developing field, there are some indications that suggest a positive correlation between geomagnetic anomalies and biological reactions. Several studies have found statistical significance between the influence of geomagnetic activity levels and higher rates of leukemia, high blood pressure, increases in depression, and severe migraine attacks, among other conditions (Mavromichalaki et al., 2016)¹⁵ (Unger, 2019)¹⁶ (Vencloviene and Babarskiene, 2016)¹⁷ (Zenchenko and Breus, 2021).¹⁸ These impacts are likely to be more pronounced in unprotected astronauts.

Additional vulnerable populations are the elderly, low-income or linguistically isolated populations, people with life-threatening illnesses, those that are electricity-dependent, and residents living in areas that are isolated from major population centers. Power outages can be life-threatening to those dependent on electricity for life support. According to the US Department of Health and Human Services, there are 21,445 electricity-dependent Medicare beneficiaries in Adams and Jefferson Counties.

Property

All property would be equally vulnerable to space weather. It is unlikely that the impacts of space weather would have a negative impact on the structures themselves.

Critical Facilities

Geomagnetic storms and EMP events have the potential to damage electronic equipment throughout North America's critical infrastructure, specifically high voltage transformers, power systems and Supervisory Control and Data Acquisition systems. It is hard to overstate how dependent modern society is on electricity. Electricity powers almost every aspect of our daily lives, from our homes and workplaces to transportation and communication systems. Hardening the country's infrastructure against geomagnetic events will be expensive and require substantial time and financial resources.

Economy

Impacts to the economy resulting from a space weather event will likely be the result of disruptions to the power grid, satellite and GPS networks, and communications lines, and the numerous cascading impacts

¹⁴ Laštovička, J., R. A. Akmaev, G. Beig, J. Bremer, J. T. Emmert, Ch Jacobi, Martin J. Jarvis, G. Nedoluha, Yu I. Portnyagin, and T. Ulich. "Emerging pattern of global change in the upper atmosphere and ionosphere." In *Annales Geophysicae*, vol. 26, no. 5, pp. 1255-1268. Copernicus GmbH, 2008.

¹⁵ Mavromichalaki, H., Papailiou, M., Dimitrova, S., Babayev, E., and Loucas, P. "Space weather hazards and their impact on human cardio-health state parameters on Earth." *Natural hazards* 64 (2012): 1447-1459.

¹⁶ Unger, S. "The Impact of Space Weather on Human Health." *Biomed J Sci & Tech Res* (2019) 22(1)-2019. BJSTR. MS.ID.003709

¹⁷ Vencloviene, J., Antanaitiene, J., and Babarskiene, R. "The association between space weather conditions and emergency hospital admissions for myocardial infarction during different stages of solar activity." *Journal of Atmospheric and Solar-Terrestrial Physics* 149 (2016): 52-58.

¹⁸ Zenchenko, T. A., & Breus, T. K. "The possible effect of space weather factors on various physiological systems of the human organism." *Atmosphere* 12, no. 3 (2021): 346.

of disruptions to those lifelines. These disruptions could impact supply chains and transportation networks, which in turn may hinder economic activity.

Historical, Environmental, Cultural Resources

Environmental vulnerability will typically be the same as exposure.

Development Trends

Geomagnetic events pose a significant, though remote, risk for future development, especially for communication and power systems. To mitigate the impact of geomagnetic events, future development must consider redundancy in critical systems. All critical facilities, including power grids and communication networks, should consider including backup power and communication systems. In addition, the implementation of advanced warning systems and protocols for geomagnetic events can help organizations prepare for and respond to potential disruptions.

4.3.15 Tornado

Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Tornado	A	2	1	3	A3

Hazard Problem/Description

Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes are the most powerful storms that exist. They can have the same pressure differential that fuels 300-mile wide-hurricanes across a path less than 300 yards wide. Closely associated with tornadoes are funnel clouds, which are rotating columns of air and condensed water droplets that unlike tornadoes, do not make contact with the ground.

Most tornadoes in the United States occur in the central plains, with the greatest likelihood of twisters in the southern plains around Kansas, Texas, and Oklahoma. According to The Denver Post’s 2017 article, Colorado ranks 9th among the 50 states in frequency of tornadoes since 1950, but 31st for the number of deaths (five) reflecting the relatively low intensity of most Colorado tornadoes. Nationwide, Colorado ranks 32nd for injuries (289) and 25th for property losses due to tornadoes. The peak season for tornadoes is in the spring and early summer with June being the most active month because the weather patterns that are needed for tornado development are most common in the spring and early summer.

Tornadoes can occur any time of the day, but most tornadoes occur in the afternoon or evening and usually move southwest to northeast. In Colorado, the largest number develop to the east of I-25.

Most tornadoes are not powerful enough to cause widespread damage; according to the NWS, 89% have a life span of less than 10 minutes and result in less than 5% of tornado fatalities. These weaker tornadoes typically have wind speeds less than 110 mph, which will damage a wood frame construction home but may completely destroy a mobile home or outbuilding.

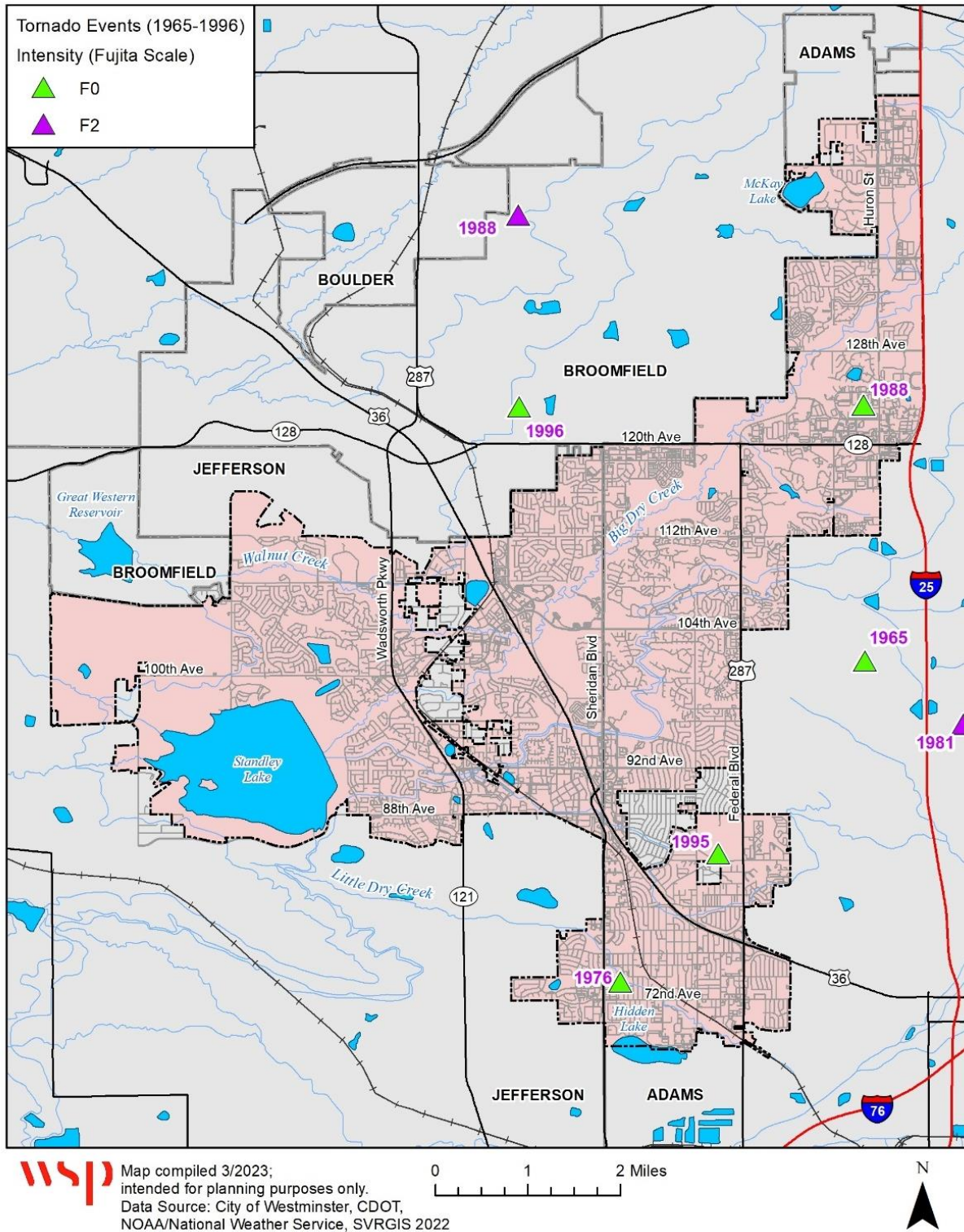
Of the 10% of tornadoes that are considered strong, some may last 20 minutes or more and cover distances in excess of 20 miles. These major tornadoes can have speeds to 165 mph, account for 30% of tornado deaths and will cause considerable damage to almost any type of structure.

The remaining 1% of tornadoes are considered violent in nature and result in 70% of tornado fatalities. They simply destroy everything in their paths, can last more than an hour and travel more than 50 miles. The only chance for survival in a violent tornado is inside a safe room or underground shelter.

Geographical Area Affected

Any area of Westminster is susceptible to a tornado and its impacts. According to records of past events the risk tends to be greater farther east, particularly in the northeast where the Denver International Airport is located. Figure 4-38 shows the location of past tornado events in the City from 1950 to 2019.

Figure 4-39 City of Westminster Tornado Weather Events by Magnitude (1950 – 2021)



Magnitude/Severity

Critical – Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, most injuries and deaths result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying the necessary emergency response.

In 2007, the NWS began rating tornadoes using the Enhanced Fujita Scale (EF-scale). The EF-scale is a set of wind estimates (not measurements) based on damage. It uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to the 28 indicators. These estimates vary with height and exposure. Standard measurements are taken by weather stations in open exposures. Table 4.47 describes the EF-scale ratings versus the previous Fujita Scale used prior to 2007 (NOAA 2007).

Table 4-48 The Fujita Scale and Enhanced Fujita Scale

F Number	Fujita Scale		Derived		Operational EF-Scale	
	Fastest ¼ Mile (mph)	3-Second Gust (mph)	EF Number	3-Second Gust (mph)	EF Number	3-Second Gusts (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Source: NWS. Notes: EF – Enhanced Fujita F – Fujita mph – Miles per Hour

Figure 4-39 illustrates the potential impact and damage from a tornado.

Figure 4-40 Potential Impact and Damage from a Tornado



Source: NOAA NWS, Storm Prediction Center

Most of the past tornado events that have happened in Adams and Jefferson Counties are small and short-lived and in the EF0 to EF 1 (F0 and F1) categories. Larger tornadoes are possible, with an F2 being the largest recorded as noted in the next section.

The NOAA’s storm prediction center issues tornado watches and warnings for the City of Westminster:

- **Tornado Watch**—Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- **Tornado Warning**—A tornado has been sighted or indicated by weather radar. Take shelter immediately.

The peak season is mid-May through mid-August, with June the most active month. However, there is no hard and fast rule for when tornadoes strike, as Colorado witnessed on March 29, 2007 when Holly, Colorado was struck by an EF-3 tornado with winds of 165 mph. Two women lost their lives as a result of that event. Nine people got injured. Over 200 residences and other buildings were affected or destroyed.

Past Occurrences

According to NCEI database, From 1950 to 2022, there were 196 reported tornadoes in the Counties of Adams and Jefferson that resulted in no death, 43 injuries, \$29.4 million property damage and \$6.5 million crop damage. Among all these events, only one event specifically happened within the City of Westminster. This event was on June 6, 1995, and was rated F0. This event did not result in any damage or fatalities.

The most significant tornado events that have happened in Adams and Jefferson Counties are described below:

July 13, 1996: May 17, 1978: A F2 tornado event was recorded in Adams County; this event resulted in \$250,000 in property damage.

June 5, 1988: A F2 tornado event was recorded in Adams County; this event resulted in \$250,000 in property damage.

June 3, 1981: A tornado was spotted 4 miles northeast of the Rocky Mountain Arsenal, moving northeast. This event was rated as F2 and resulted in 42 injuries, \$27.8 million in property damage, and \$6.5 million in crop damage. This is the most damaging tornado event in the history for the area.

May 17, 1978: A F2 tornado event was recorded in Adams County; this event resulted in \$250,000 in property damage.

May 30, 1976: A F2 tornado event was recorded in Adams County; this event resulted in \$250,000 in property damage.

Figure 4-41 shows the location of past tornado events in the City. There were 2,118 tornadoes in Colorado between 1950 and 2016. Of these, 123 were within 20 miles of Westminster. The National Weather Service reports the north metro area averages one confirmed tornado each year since 1950. The ongoing development of the area will increase the probability of property damage. Tornadoes typically occur April through June. However, tornadoes are possible during other months of the year as well. Tornadoes occur primarily East of I-25. Tornadoes can pose a danger to populations that may be caught out of doors at open air events or in open spaces.

Table 4-49 Westminster Tornadic Events

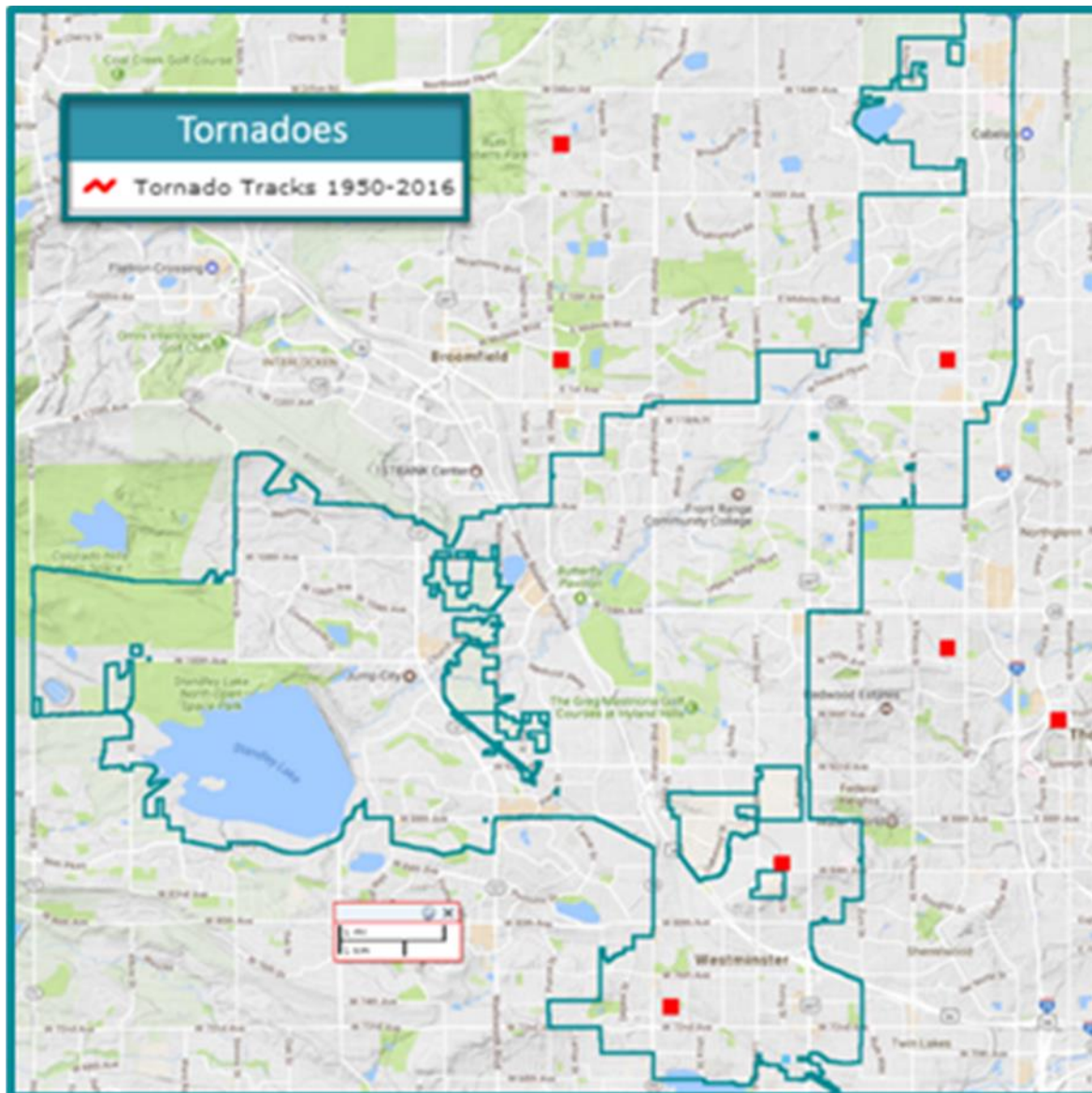
Date	Scale	Length of Track (miles)
June 4, 1976	F-0	.009 miles

Date	Scale	Length of Track (miles)
April 21, 1988	F-0	.009 miles
June 6, 1995	F-0	.009 miles

Source: NOAA NCEI

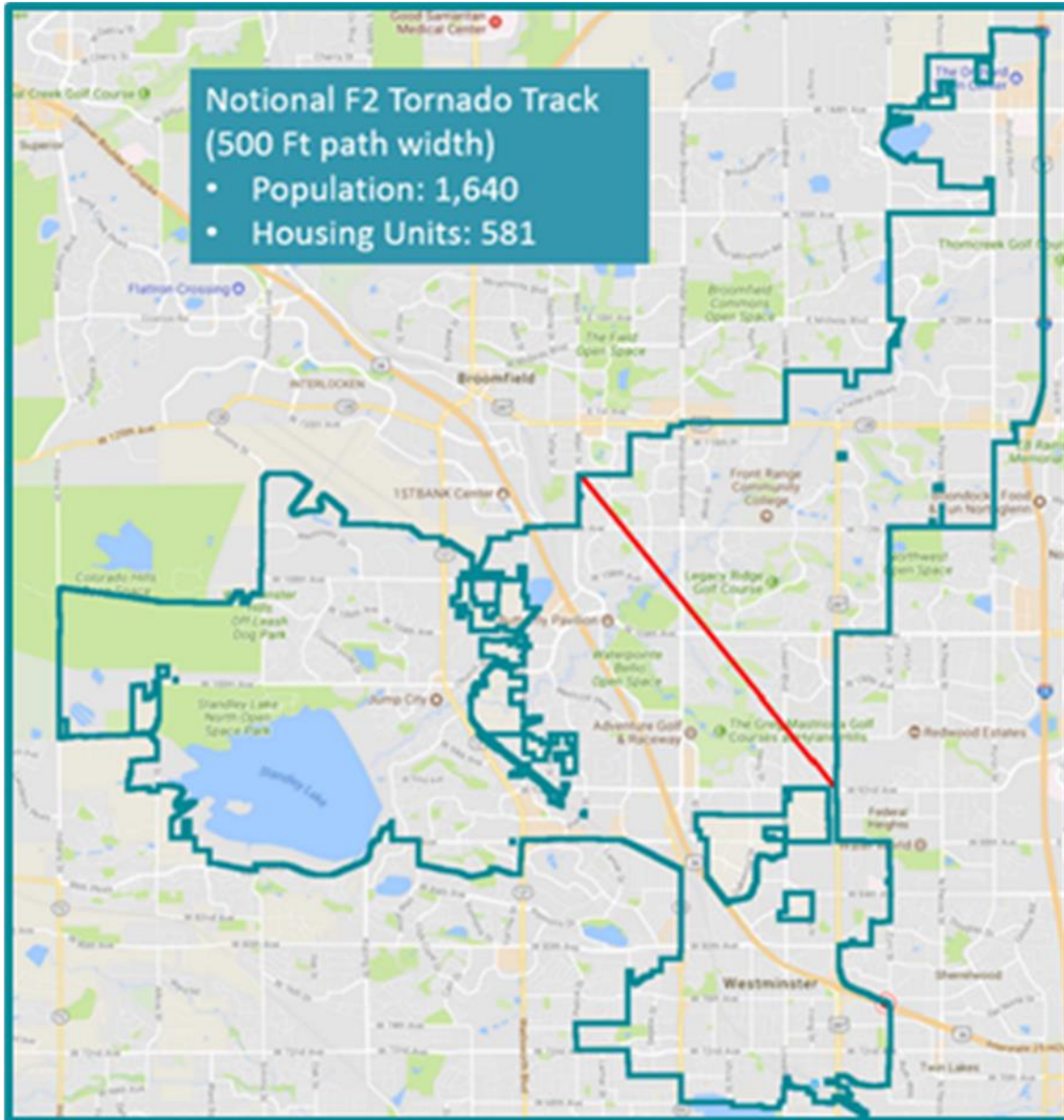
The National Weather Service has documented three tornadic events in Westminister between 1950 and 2016. These touchdown events were in the F0 scale (65-85 mph winds, minor or no damage) with no reported injuries or damage. In June 1981, an F-2 tornado touched down approximately three miles east of Westminister in Thornton. The tornado injured 42 people and did significant damage to several homes. F1 (86-110 mph) and F2 (111-135 mph) have occurred in the communities surrounding Westminister.

Figure 4-41 Tornado Events in City of Westminister 1950-2016



Source: NOAA Storm Events Database

Figure 4-22 Hypothetical Tornado Impacts



Source: City of Westminister

Frequency/Likelihood of Occurrence

Historically, Adams and Jefferson Counties experienced 196 recorded tornadoes between 1950 and 2022 (73 years). This equates to an approximate average of three tornado occurrence every year. However, this likelihood of occurrence is likely an overestimation for the City of Westminister as it is based on the previous occurrences in Adams and Jefferson Counties. On the other hand, there is a risk of tornado formation during any severe thunderstorm, which occur almost every year in Westminister.

Climate Change Considerations

More research is needed to understand how climate change will affect tornado events. These events occur over much smaller scales, which makes observations and modeling more challenging. Projecting the future influence of climate change on these events can also be complicated by the fact that some of

the risk factors for these events may increase with climate change, while others may decrease. Even though some studies predict that climate change could provide the opportunity for more severe thunderstorms to form, this does not necessarily mean that more tornadoes will occur, given that only about 20% of supercell thunderstorms produce tornadoes. The fourth National Climate Assessment summarizes the complicated relationship between tornadoes and climate change: "...extreme weather, such as tornadoes, are also exhibiting changes which may be linked to climate change, but scientific understanding isn't detailed enough to project direction and magnitude of future change." ("Tornadoes And Climate Change" 2022)

Vulnerability Summary

People

Populations vulnerable to tornadoes include people caught outside during a storm and people without adequate shelter such as a basement or a safe room. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters all reduce the exposure of the population.

People can be injured in a variety of ways during a tornado, including being directly picked up or thrown by wind gusts, being hit by debris, or being in a structure destroyed during a tornado. Since 1950, Adams and Jefferson Counties have experienced 43 recorded injuries and no fatalities directly caused by tornado events. As mentioned above, On June 3, 1981, 42 people were injured during a F2 tornado event.

The elderly, individuals with disabilities, and others with access and functional needs, especially those with home health care services rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, residential facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. Power outages can be life-threatening to those dependent on electricity for life support.

Property

General damages are both direct – what the tornado physically destroys – and indirect – additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and the length of time a property is exposed to the incident, a tornado is capable of damaging and eventually destroying almost anything. As discussed by National Geographic in the article – Tornadoes, Explained, which was published on August 28, 2019, every year in the United States, tornadoes do about 400 million dollars in damage and kill about 70 people on average.

Construction practices can help maximize the resistance of the structures to damage, but it is difficult to project these impacts into general vulnerability assessments because of the variability of the construction uses. Some vulnerable construction includes mobile home parks.

Highway and public works crews remove debris from roadways. Victims and their insurance agents need access to the properties to assess the damage and search for valuables or heirlooms.

Critical Facilities

In the immediate aftermath, the focus is on emergency services. Law enforcement activities focus on scene security. Fire and Emergency Medical Services (EMS) personnel rescue the injured, put out any fires caused by broken gas lines or other similar hazards and assist in the cleanup. Utility crews restore power, phone, communications, and other utility services. Public gathering places including (but not limited to) schools, community centers, shelters, nursing homes and churches, may have increased impacts at certain times of day if struck by a tornado. Due to the random nature of these hazards, a more specific risk assessment was not conducted for this plan.

Secondary impacts of tornado damage often result from damage to critical infrastructure assets. Downed power and communications transmission lines, coupled with disruptions to transportation, create

difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community.

Economy

Economic impacts are dependent on the size and path of the tornado. A strong tornado hitting a populated business area or other critical infrastructure could have a profound economic impact. Impacts to smaller businesses would likely be more pronounced, including longer-term closures due to more destruction. Other economic impacts could include increased insurance payouts and premiums.

Historical, Environmental, Cultural Resources

High winds and tornadoes can cause massive damage to the natural environment, uprooting trees and other debris. This is part of a natural process, however, and the environment will return to its original state in time.

Development Trends

As the City of Westminster continues to add population, the number of people and housing developments exposed to the hazard increases. Proper education on building techniques and the use of sturdy building materials, basements, attached foundations, and other structural techniques may minimize the property vulnerabilities. Development of enhanced building codes may help facilitate more resilient construction and infrastructure. Public shelters at parks and open spaces may help reduce the impacts of tornadoes on the recreational populations exposed to storms; public shelters accessible to mobile home parks will also protect individuals there. It should be noted that shelters protect lives; they do not protect property.

4.3.16 Open Space Fire (Wildfire)

Hazard	Likelihood (A-E)	Impact			Overall Impact Sum of Impact divided by 3
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	
Open Space Fire	D	4	4	4	D4

Hazard Problem/Description

Wildfire has long been a major concern for Colorado residents, businesses, and government as well as the state of Colorado. In recent years there has been a growing concern for wind-driven open space and urban wildfires in communities along the Front Range. Historically, the fire season extends from spring to late fall. With the increase in average global surface temperatures, “earlier springs and hotter summers are projected throughout the state, with more frequent and severe heat waves” which has led to year-long fire seasons. 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. Wildfire risk is predominantly associated with the wildland-urban interface, areas where development is interspersed or adjacent to landscapes that support wildland fire. A fire along this wildland-urban interface can result in major losses of property and structures as well as negatively impact human health and well-being. Significant wildfires can also occur in heavily populated areas, leading to more extensive social and economic impacts and exacerbating existing inequities. Rangeland and grassland fires are a concern in the areas west of the City of Westminster, including urbanized areas, due to increased residential development in the urban-wildland interface. The Colorado Hills Open Space and Rocky Flats National Wildlife Refuge are both located directly west of Westminster and could provide an opportunity for a wildfire to break out that could quickly turn into a wind-driven fire progressing towards urbanized areas of Westminster.

The natural landscape of Westminster is dominated by rolling hills, short prairie grasses, seasonal streams and dry gulches which support native trees and brush. The city’s policy of maintaining 15% of the city’s total area as managed open space helps preserve the natural environment, provides a home to wildlife, and enhances the quality of living and outdoor recreation for our residents. The annual cost of maintaining the city’s open space was estimated to be \$1.5 million (\$500 per acre) in 2014. This

significant investment reflects the importance of this community resource to our residents and leadership. The city owns 3,067 acres as managed open space and 109 miles of trails. Most of the urban natural landscape is in corridors along the Big Dry Creek and Walnut Creek drainages and is characterized by native grasses and Cottonwood trees. The open spaces often abut residential and commercial property. Open space and undeveloped property pose a threat of brush fires throughout the year. Periods of low humidity, lack of precipitation, and high winds provide ideal conditions for ignition. Drought conditions may significantly increase the potential for wildland fires. (StudioCPG and ERO Resource Corporation 2014)

Generally, 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: 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. Also, to be considered as a fuel source are manmade structures, such as homes and associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for fire spread. In addition, "ladder fuels" can spread a ground fire up through brush and into trees, leading to a devastating crown fire that burns in the upper canopy and cannot be controlled. The volume of available fuel is described in terms of fuel loading. The presence of fine fuels, 1,000-hour fuels, and needle cast combined with the cumulative effects of previous drought years, vegetation mortality, tree mortality, and blowdown across areas near the City of Westminster has added to the fuel loading in the area. Fuel is the only factor that is under human control however, drought conditions and vegetation mortality will continue to increase due to our rapidly warming climate requiring increased capacity and funding to proactively control fuel sources.

Topography: The City of Westminster's terrain and land slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.

Weather: Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. Weather and climate are addressed together later in this section since weather is short-term changes in the atmosphere and climate is trends in weather over a longer period of time. Since climate is changing so rapidly, these two elements are highlighted below.

Urban Fire Considerations

There are numerous contributing factors that increase the risk of wind-driven fire in urban areas. The increasing use of engineered materials in building construction over the past 30 years has resulted in structures that burn much more quickly and intensely. The cost of land and construction and need for more housing have resulted in more closely built structures and more multi-family structures. Urban landscaping produces substantial amounts of light fuels that easily collect in gutters, near foundations, and along fences. These light fuels are easily ignited and readily spread flames to fences and structures. Neighborhoods often have a limited number of access points to limit the flow of traffic but create unintended obstacles to rapid evacuation.

Westminster actively works to reduce the risk of fire in the city through community planning, fire codes, inspections, enforcement, and public education. In addition to a well-staffed, equipped, and trained professional fire department, the city maintains a robust firefighting water supply accessible through over 6,000 hydrants. Wind-driven fire in our suburban environment presents a distinct hazard with the potential to become an extremely deadly and destructive conflagration in which rapid mass notification and evacuation are the only option.

Past Occurrences

According to the Colorado State Forest Service, vegetation fires occur on an annual basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and

become wildfires, damage can be extensive. Climate change is likely to increase the frequency and size of wildfires in the region leading to more severe damage and impacts to quality of life. Climate change is just one human-caused element making wildfires more likely and deadly. Additionally, human decision-making error attributed to activities such as smoking, uncontrolled campfires, equipment use, and arson are also contributors. In the late 1990s, a wind-driven (60-70 mph) open space fire destroyed several buildings on the historic Shoenberg farm site (McQuiston 2017). A wind-driven grass fire on the Rocky Flats area to the west of the city rapidly burned several hundred acres, caused the evacuation of the Walnut Creek neighborhood and threatened several homes before it was brought under control by the Westminster Fire Department and several of its mutual aid partners. Figure 4-42 below shows the locations and extent of past wildfires in the greater vicinity of the City of Westminster between 1951 and 2022. Each of these events, and future ones of similar scale and location, have the potential to cause negative impacts in Westminster, despite burning many miles away.

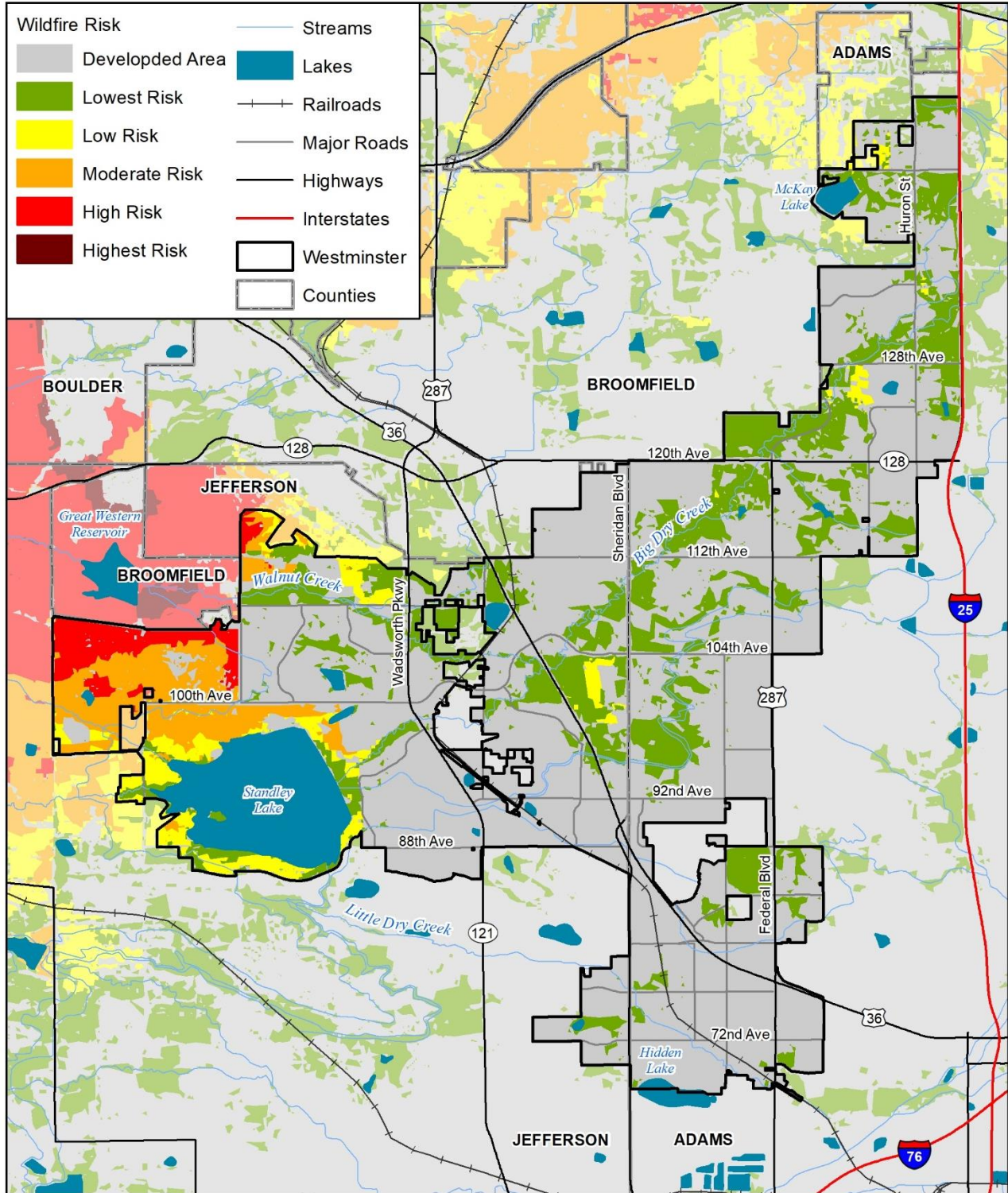
Between 2012 and 2021, Colorado Front Range communities experienced five wind-driven fires that spread from undeveloped areas into suburban communities. These fires burned 132,085 acres and 2,360 structures. The 2021 Marshall Fire, which ignited on the morning of December 30, 2021, and rapidly grew into a fast-moving grassland fire near Marshall Lake in nearby unincorporated Boulder County, came within 2 miles of the northwestern edge of Westminster. Dry conditions and very high winds gusting up to 115 mph drove the fire east towards suburban communities in Superior and Louisville. Evacuation orders were issued for tens of thousands of residents in the town of Superior and the cities of Louisville, Broomfield, and unincorporated Boulder County. The fire was eventually contained with a combination of extensive response by firefighters and heavy snowfall the following evening. From December 30-31, approximately 6,074 acres were burned, 1,084 buildings destroyed, and approximately \$513 million in damages. One person was confirmed dead as a result of the fire, and another is missing and presumed dead. Within 12 hours of igniting the Marshall Fire had already become the most destructive fire in Colorado state history in terms of structures lost. Westminster has experienced structure fires in which wind accelerated the fire behavior and helped spread the fire to neighboring structures. The Marshall Fire presents an example of the potential danger of a wind-driven fire in a modern suburban environment.

Geographical Area Affected

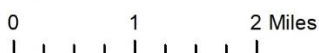
Much of the area within the City of Westminster's boundaries is developed and presents a minimal risk for the ignition of large open space or wind-driven fires. However, there are also many open space areas and greenbelts, as well as large swaths of land around Standley Lake and to the west of the city, which pose a threat for the potential ignition and further spread of fires.

The Colorado Forest Atlas, formerly known as the Colorado Wildfire Risk Assessment Project (CO-WRAP) is an initiative led by the Colorado State Forest Service to provide information to the public and wildfire professionals to identify areas in need of wildfire planning, disseminate information, encourage collaboration, plan response actions, and prioritize fuels treatments in the state. The Colorado Forest Atlas calculates a composite risk rating, defined as the possibility of loss or harm occurring from a wildfire. It identifies areas with the greatest potential impacts from a wildfire – i.e., those areas most at risk – considering all values and assets combined together – wildland urban interface (WUI) Risk, Drinking Water Risk, Forest Assets Risk and Riparian Areas Risk. This risk index has been calculated consistently for all areas in Colorado, allowing for comparison and ordination of areas across the entire state. The wildfire risk classes in and around the City of Westminster are shown in Figure 4-43 below.

Figure 4-44 Wildfire Risk, City of Westminster

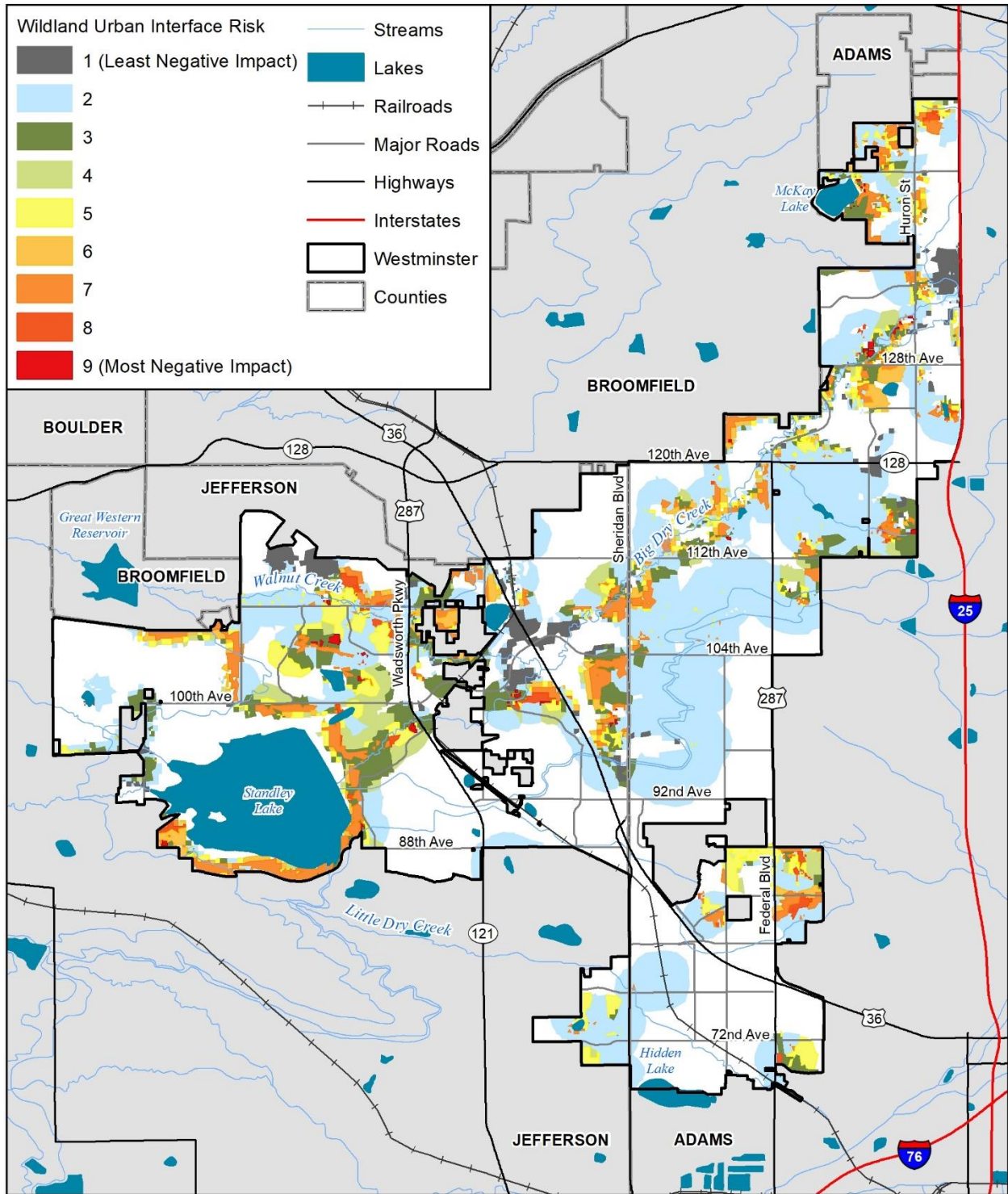


Map compiled 11/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
Colorado Forest Atlas – Colorado State Forest Service



The areas of greatest concern for wildfire risk are in the WUI, where development is interspersed or adjacent to landscapes that support wildland fire. While traditionally associated with forested mountain areas, WUI areas are also present in grasslands, prairies, valleys, or in any area where a sustained wildfire may occur and impact developed areas. As previously mentioned, the 2021 Marshall Fire is perhaps the greatest example of this risk. Fires in the WUI may result in major losses of property and structures, threaten greater numbers of human lives, and incur larger financial costs. In addition, WUI fires may be more dangerous than wildfires that do not threaten developed areas, as firefighters may continue to work on more dangerous conditions in order to protect structures such as businesses and homes. Increased development in WUI areas puts more people and structures potentially at risk. Figure 4-44 shows WUI areas within the City of Westminster as determined by the Colorado Forest Atlas. CO-WRAP defines the WUI using housing density data to delineate where people and structures meet and intermix with wildland fuels.

Figure 4-45 City of Westminster Wildland Urban Interface (WUI) Areas



Map compiled 11/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
Colorado Forest Atlas – Colorado State Forest Service



Magnitude/Severity

Colorado Forest Atlas provides a description of fire intensity potential based on the conditions with the general vicinity of Westminster. The tool uses the Fire Intensity Scale (FIS) layer, which uses fuels, topography, and weather as inputs to determine potential fire intensity for a given location. FIS consist of five classes, where the order of magnitude between classes is ten-fold. The minimum class (Class 1) represents very low wildland fire intensities, and the maximum class (Class 5) represents very high wildland fire intensities. A visual representation of the map key is below.

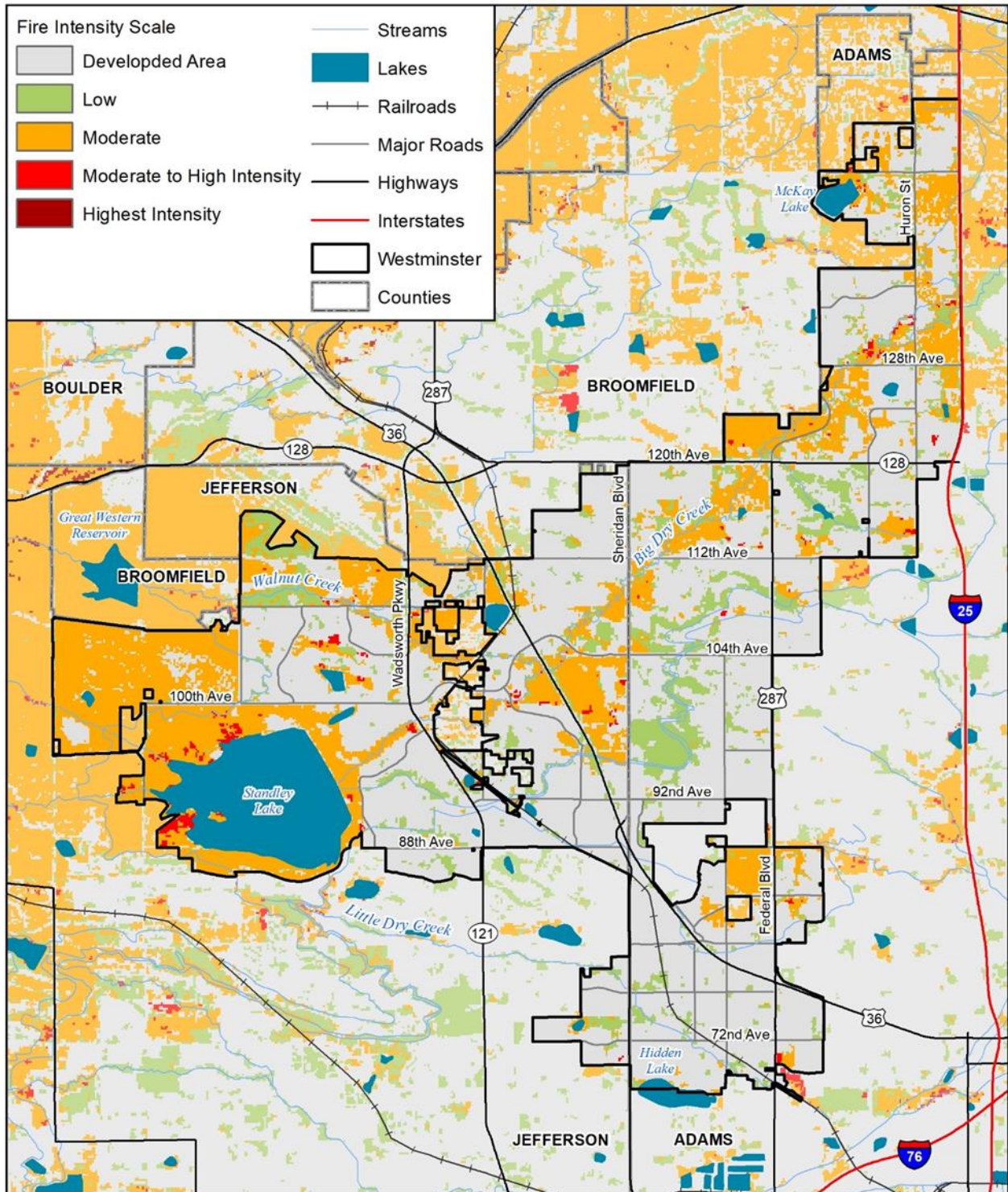
Figure 4-46 Fire Intensity Scale

Class 1 (Lowest Intensity)	Class 2	Class 3	Class 4	Class 5 (Highest Intensity)
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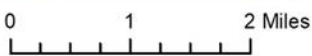
- **Class 1 – Lowest Intensity:** Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
- **Class 2 – Low:** Small flames, usually less than two feet long; small amount of very short-range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
- **Class 3 – Moderate:** Flames up to eight feet in length; short-range spotting possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
- **Class 4 – High:** Large flames, up to 30 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
- **Class 5 – Highest Intensity:** Very large flames up to 150 feet in length; profuse short-range spotting; frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Figure 4-46 below shows the Fire Intensity Scale for Westminster and its surrounding area.

Figure 4-47 City of Westminster Wildfire Intensity Scale



Map compiled 12/2022;
intended for planning purposes only.
Data Source: City of Westminster, CDOT,
Colorado Forest Atlas – Colorado State Forest Service



The severity of a suburban wind-driven fire will be largely defined by the building materials, density, and traffic pattern of the affected community. Older neighborhoods with more greenspace, smaller homes, greater use of brick siding, and open-ended grid patterns may be less severely impacted than more recently built neighborhoods. Landscaping and maintenance may also influence the spread of a wind-driven fire. The duration of the extreme wind event and the availability of fuel will define the extent of the event which could encompass thousands of structures and endanger thousands of lives.

Frequency/Likelihood of Occurrence

Figure 4-46 above shows the history of wildfires in the larger vicinity of the City of Westminster, including nearby mountain counties. While there have not been any large, significant wildland or open space fires in the City of Westminster, there are commonly smaller brush fires which occur in the city on an almost annual basis. Any of these fires has the potential to quickly expand into a much larger wildland urban interface fire or wind-driven fire if conditions are right, similar to the destructive Marshall Fire.

Additionally, the likelihood of future large wildfires in Colorado is almost certain annually. Despite not burning nearby, these large fires can still cause considerable negative impacts to the City of Westminster despite not burning nearby such as negative impacts to air and water quality and resulting health impacts to residents. The likelihood of these impacts to the City of Westminster in the future, especially related to impacts of climate change, are very likely in the future.

Climate Change Considerations

Weather and Climate: Climate is a major determinant of wildland fire through its control of weather, as well as through its interaction with fuel availability, fuel distribution and flammability at the global, regional, and local levels. With hotter temperatures, drier soil and worsening drought conditions in the entire Western US, wildland fires have the potential to become more extreme. Currently humans are the main cause of fire ignition globally, although lightning has been predominantly responsible for large fires nearby in the Front Range. Weather components such as temperature, relative humidity, wind, and lightning affect the potential for wildfire. There is also a strong connection between climate change and wildfires. Colorado has seen significant increases in forest area burned in recent years, and the risk of wildland fires in the future are expected to increase due to a lengthening fire season and drier conditions.

- 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. Colorado has already observed increases in average temperatures and drier soils from increased evaporation which contribute to surges in wildfire activity. Increased temperatures also lead to longer breeding seasons for bark beetles which destroy forests leading to increased fuel.
- 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. As climate change increases the number of extreme weather events, it is likely that extreme winds will increase and play a role in spreading fires faster.
- Lightning also ignites wildfires, which are often in terrain that is difficult for firefighters to reach. An article in the journal *Science*, estimates that we can expect to see a 12% increase in lightning activity for every 1.8oF of global warming, translating to a potential increases of 50% in strikes by the turn of the century.
- Drought conditions contribute to concerns about wildfire vulnerability. During periods of drought, the threat of wildfire increases. Colorado is experiencing more multi-year droughts and variability in precipitation due to climate change. This trend is likely to continue leading to increased vulnerability.

According to a report from the Intergovernmental Panel on Climate Change, fire season has already lengthened by 18.7% globally between 1979 and 2013, with statistically significant increases across 25.3% but decreases only across 10.7% of Earth's land surface covered with vegetation; with even sharper changes being observed during the second half of this period. Correspondingly, the global area experiencing long fire weather season has increased by 3.1% per annum or 108.1% during 1979–2013. Fire frequencies under 2050 conditions are projected to increase by approximately 27% globally, relative

to the 2000 levels, with changes in future fire meteorology playing the most important role in enhancing global wildland fires, followed by land cover changes, lightning activities and land use, while changes in population density exhibit the opposite effects.

Vulnerability Summary

Fire is a natural element of the native grasslands and streambed vegetation of our managed open space. Natural or human-caused fires in these areas during dry and windy weather could endanger adjacent built environments. Fires in our open space areas are commonly the result of lightning, powerline failures, arson and accidents. Most brush fires are contained immediately and do not escape initial affected areas, but the potential for deaths, injuries or property losses exists.

Potential losses from wildfire include human life; structures and other improvements; natural and cultural resources; quality and quantity of the water supply; assets such as timber, range and crop land, and recreational opportunities; and economic losses. In addition, catastrophic wildfire can lead to secondary impacts or losses, such as future flooding and landslides during heavy rains.

People

The greatest risk to people from direct open space fires in the City of Westminster is to those residing in the western portions of the city around Standley Lake, and in neighborhoods adjacent to the city's open space corridors. As shown in Figure 4-44 and Figure 4-46, much of the urbanized planning area has limited wildland fire risk, but there are still an estimated 8,867 residents living within the high, moderate, low, or lowest wildland fire risk areas according to GIS analysis.

Fire can cause direct physical impacts to people, including physical injuries and burns, and breathing issues from smoke inhalation. Indirect impacts, such as widespread smoke from wildland fires occurring outside of the planning area boundaries, can still cause significant air quality issues in the cities especially for those with breathing sensitivity problems more likely to be affected by the pollutants in the air. In the summer of 2021, nearby City of Denver recorded the worst air quality of any major city in the world, recording an air quality index of 167 on August 7, 2021. This was the result of wildland fire smoke and particulate matter from some 107 wildfires which were burning across the Western US at that time. An air quality index above 100 is considered unhealthy for those with increased health risks, and above 150 is considered unhealthy for everyone. Prolonged and frequent occurrences of large fires, both in Colorado and other western states, can result in these conditions which can harm the population.

Property

Any flammable materials are vulnerable during a wildland fire, including structures and personal property. The vulnerability of general property increases with proximity to wildland fire-prone areas. These structures receive an even higher level of vulnerability if the properties surrounding them are not properly mitigated for fire. Appropriate mitigation techniques include using non-flammable materials such as ignition-resistant construction, leaving appropriate spaces between buildings and vegetation, landscaping with non-flammable materials (such as decorative rock or stone), and clearing of underbrush and trees. If a wildland fire were to cross completely into an urban zone, the damage could be extensive and there would likely be a higher loss as property and homes themselves become fuel in extreme fire weather conditions. The aftermath of the Marshall Fire served to illustrate just how extensive this potential threat could be for communities along the Front Range.

Table 4.49 below summarizes this risk to structures in Westminster, based on a GIS analysis conducted for this vulnerability assessment. GIS was used to overlay improved parcels with the wildfire risk layers from Colorado Forest Atlas to evaluate the numbers, types, and values of properties and structures exposed to wildfire in the City of Westminster. Property improvement values for the points were based on the assessor's parcel data and summed by parcel type, along with content values and total values.

Table 4-50 Westminster Properties at Risk to High, Moderate, and Low Wildfire Hazards

Property Type	Improved Parcels	Building Count High	Building Count Moderate	Building Count Low	Total Building Count	Improved Value	Estimated Content Value	Total Value
Agricultural	0	0	0	0	0	\$0	\$0	\$0
Commercial	1	0	1	1	2	\$224,776	\$224,776	\$449,552
Exempt	0	0	0	1	1	\$324,306	\$324,306	\$648,612
Industrial	0	0	0	0	0	\$0	\$0	\$0
Mixed Use	1	0	1	0	1	\$275,480	\$275,480	\$550,960
Multi-Family	0	0	0	0	0	\$0	\$0	\$0
Residential	20	3	17	38	58	\$66,585,292	\$33,292,646	\$99,877,938
Total	22	3	19	40	62	\$67,409,854	\$34,117,208	\$101,527,062

Source: Jefferson and Adams County Assessor Data 2022, Colorado Forest Atlas, WSP GIS Analysis

Critical Facilities

According to analysis on data from Colorado Forest Atlas, 10 critical infrastructure facilities across the city have been identified in areas with some level of fire risk. One facility is in an area with high risk, and 9 facilities are in areas of low risk.

Table 4-51 Critical Facilities at Risk to Wildfire by Risk Ranking

Wildfire Risk	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Highest	-	-	-	-	-	-	-	0
High	-	-	-	-	-	1	-	1
Moderate	-	-	-	-	-	-	-	0
Low	-	-	-	-	-	-	-	0
Lowest	3	-	-	1	3	-	2	9
Total	3	0	0	1	3	1	2	10

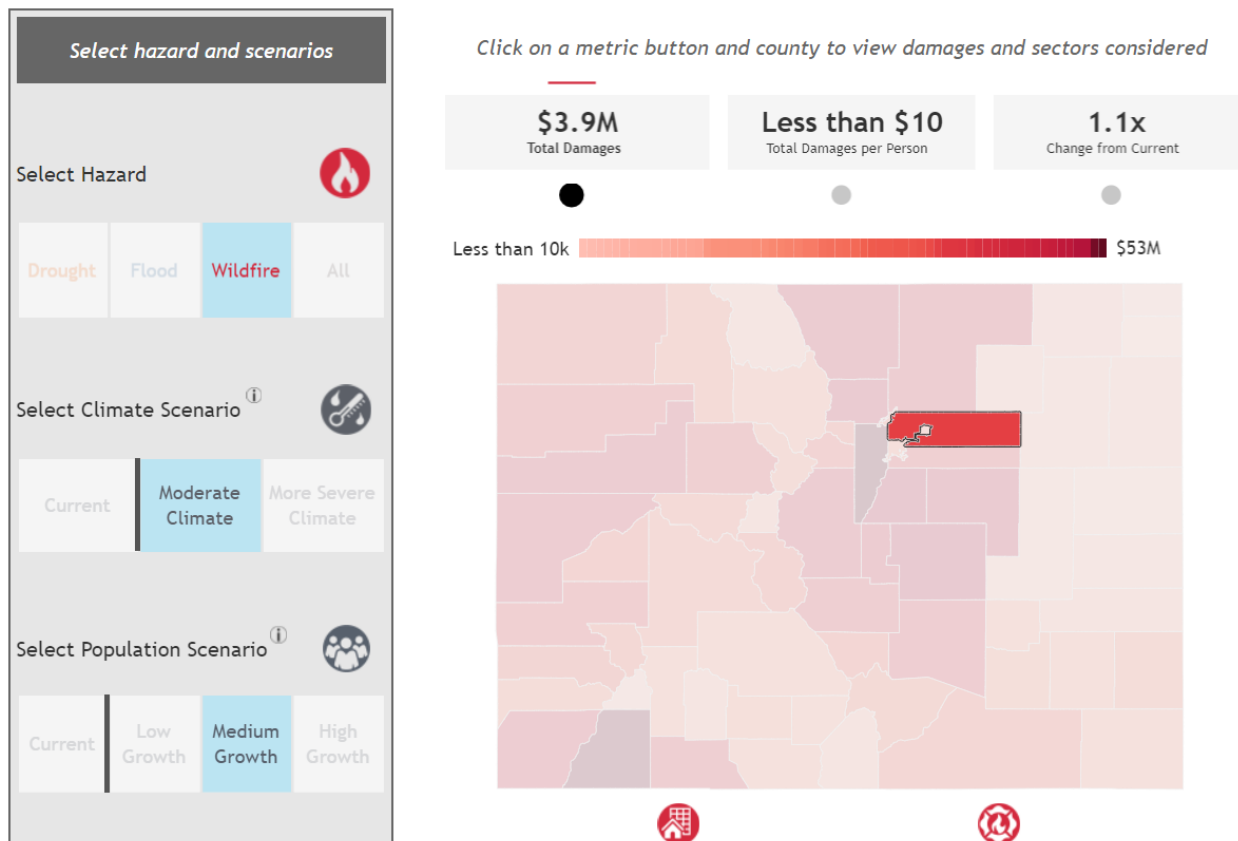
Source: City of Westminster, CDHE, CEPC, HIFLD, NBI, Colorado Forest Atlas, WSP GIS Analysis

Economy

A major wildland fire can cause devastating economic impacts, depending on the parameters and size of the fire. Direct impacts to businesses would most likely only occur in an event like the Marshall Fire, where wind-driven flames reach further into the urbanized areas of the city. In the Marshall Fire, 11 commercial properties were lost, including big box stores and a hotel. Economic impacts could include direct fire damage to buildings and facilities, cascading impacts to industries and supply chains, road closures and the accumulation of fire suppression costs.

The Colorado Water Conservation Board FACE tool provides an assessment of the potential future impacts of wildfire under various growth and climate scenarios. Impacts are reported in terms of expected annual damages: the expense that would occur in any given year if monetary damages from all hazard probabilities and magnitudes were spread out over time (units = 2019 dollars). The FACE tool analysis is only available at county scales but is required by the State of Colorado for hazard mitigation plans; Adams County was chosen as the representative county for the purposes of this Plan. According to CWCB FACE analysis tool, Adams County could potentially experience \$3.9 million in future losses due to wildfire under medium population growth and moderate climate scenarios. This is shown in Figure 4-48 below.

Figure 4-48 Adams County CWCB FACE Tool Results – Wildfire



Source: Colorado Water Conservation Board, <https://cwcb.colorado.gov/FACE>

Historical, Environmental, Cultural Resources

Wildfires have both positive and negative impacts on the natural environment. They impact air quality, water quality, and vegetation. Small fires can help an ecosystem regenerate and increase biodiversity; however, large wildfires can impact the ability of an ecosystem to recover and have the potential to permanently damage native vegetation and species.

- **Air Quality:** Wildfires generate smoke which is made up of gases, water vapor and microscopic particles. The small particles are referred to as PM which impacts air quality tremendously and has a range of negative impacts on the human body including difficulty breathing, heart stress and irritation to eyes. Smoke from fires can travel long distances and will impact humans and animals.
- **Water Quality:** Wildfires can have impacts on water quality for years and even decades. Wildfires increase stormwater runoff through reduction in vegetation and degradation of soil. Without vegetation to slow the flow of water down, runoff water transports sediment and debris into nearby water bodies. This impacts nutrient levels and can also result in algal blooms that impact downstream waterbodies.

- **Vegetation and Biodiversity:** Trees and vegetation are important for wildfire management and human health. Diverse vegetation and promotion of ecosystem resilience will help to improve biodiversity and reduce fire risk.

Development Trends

Future development is an important factor to consider in the context of wildfire mitigation because development and population growth can contribute to increased exposure of people and property to wildfire. Although Westminster is not expected to expand a great deal in the future, during the past few decades' population growth in the planning area WUI has increased greatly. Subdivisions and other high-density developments have created a situation where wildland fires can involve more buildings and people. By identifying areas with significant potential for population growth and/or future development in high-risk areas, communities can identify areas of mitigation interest and reduce hazard risks associated with increased exposure.

4.3.17 Windstorm

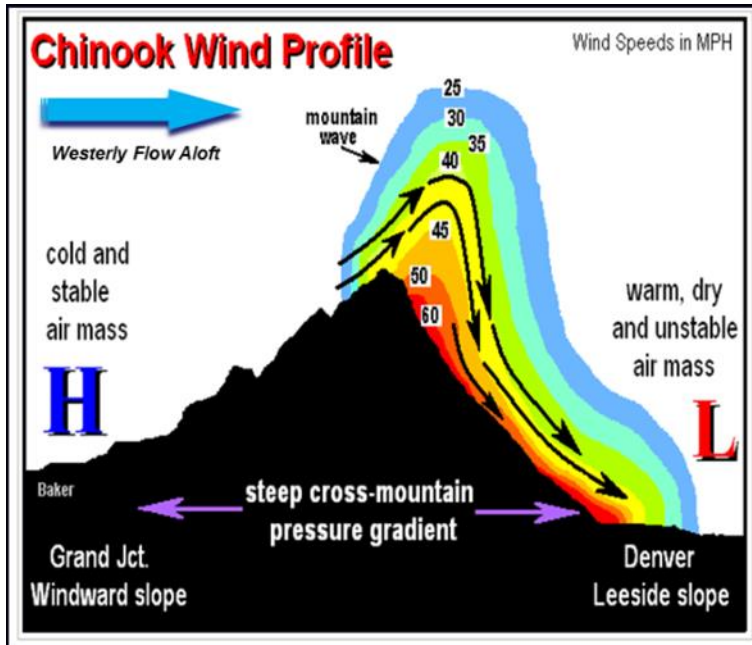
Hazard	Likelihood (A-E)	Impact			Overall Impact
		Scale (1-5)	Durations (1-5)	Consequences (1-5) X 2	Sum of Impact divided by 3
Windstorm	E	4	2	1	E2

Hazard/Problem Description

Windstorms are defined as a storm with high winds or violent gusts. Downslope winds in Colorado are referred to as Chinook winds, after the Native American tribe of the Pacific Northwest. Chinook winds are warm dry wind that descends from the eastern slopes of the Rocky Mountains, causing a rapid rise in temperature. Sometimes these winds move at considerable force.

Two main causes of high winds in Colorado during the cold season are the air pressure difference between strong low pressure and cold high-pressure systems, and Chinook winds developing along the Front Range and mountains in the eastern half of the state. Steep pressure gradient (or large horizontal difference in air pressure) between a pressure maxima or high-pressure (H) in western Colorado and a pressure minima or low pressure (L) in northeast Colorado is necessary for the formation of strong and gusty Chinook winds on and near the east face of the Front Range. Strong westerly flow aloft will further strengthen this downslope wind. Figure 4-47 below shows the formation of Chinook Winds. A strong low-pressure system in Colorado, coupled with a high-pressure system to the west, can send a cold wind, called a Bora, through the western part of the state and down the slopes of the eastern mountains. The result can be a cascade of high winds from the west or northwest into the adjacent plains at speeds over 100 mph. The damage caused by this event is usually much more widespread than that caused by a severe thunderstorm in the warm season.

Figure 4-49 Chinook Winds



Source: Mountain Wave Weather NOAA

Jet stream winds over Colorado are much stronger in the winter than in the warm season, because of the big difference in temperature from north to south across North America. Very swift west winds, under certain conditions, can bring warm, dry Chinook winds plowing down the slopes of the eastern mountains. These winds can also exceed 100 mph in extreme cases, again bringing the potential for widespread damage.

Straight-line wind events of more than 40 mph are not unusual for Westminster. They are predictable and provide an opportunity to take routine measures to mitigate their impacts. Airborne debris has the potential to cause injuries and damage property. Chinook winds can cause thousands of dollars in damages to property and trees. Wind events in conjunction with open space fire, hail or winter storms can greatly exacerbate the consequences of these hazards.

Severe windstorms pose a significant risk to life and property in the region by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. Thus, high winds can have destructive impacts, especially to trees, power lines, and utility services. In the Front Range, including the City of Westminster, windstorms can occur at any time of year.

Geographical Area Affected

Any area of Westminster is susceptible to windstorm events. Previous instances of windstorm events in the City are shown in Figure 4-48.

Magnitude/Severity

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Windstorms in Westminster are rarely life-threatening, but do disrupt daily activities, cause damage to buildings and structures, and increase the potential for other hazards, such as infrastructure failure.

While scales exist to measure the effects of wind, they can be conflicting or leave gaps in the information. For the purposes of this plan, the Beaufort Wind Scale was used because it is specifically adapted to wind effects on land. Westminster can experience all 12 Beaufort categories.

Table 4-52 Beaufort Wind Scale

Force	Wind (mph)	Classification	On Land
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-7	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	8-12	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	13-18	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches moved
5	19-24	Fresh Breeze	Small trees in leaf begin to sway
6	25-31	Strong Breeze	Larger tree branches moving, whistling in wires
7	32-38	Near Gale	Whole trees moving, resistance felt walking against wind
8	39-46	Gale	Twigs breaking off trees, generally impedes progress
9	47-54	Strong Gale	Slight structural damage occurs
10	55-63	Storm	Trees broken or uprooted, "considerable structural damage"
11	64-72	Violent Storm	Widespread structural damage
12	72+	Hurricane	Considerable and widespread damage to structures

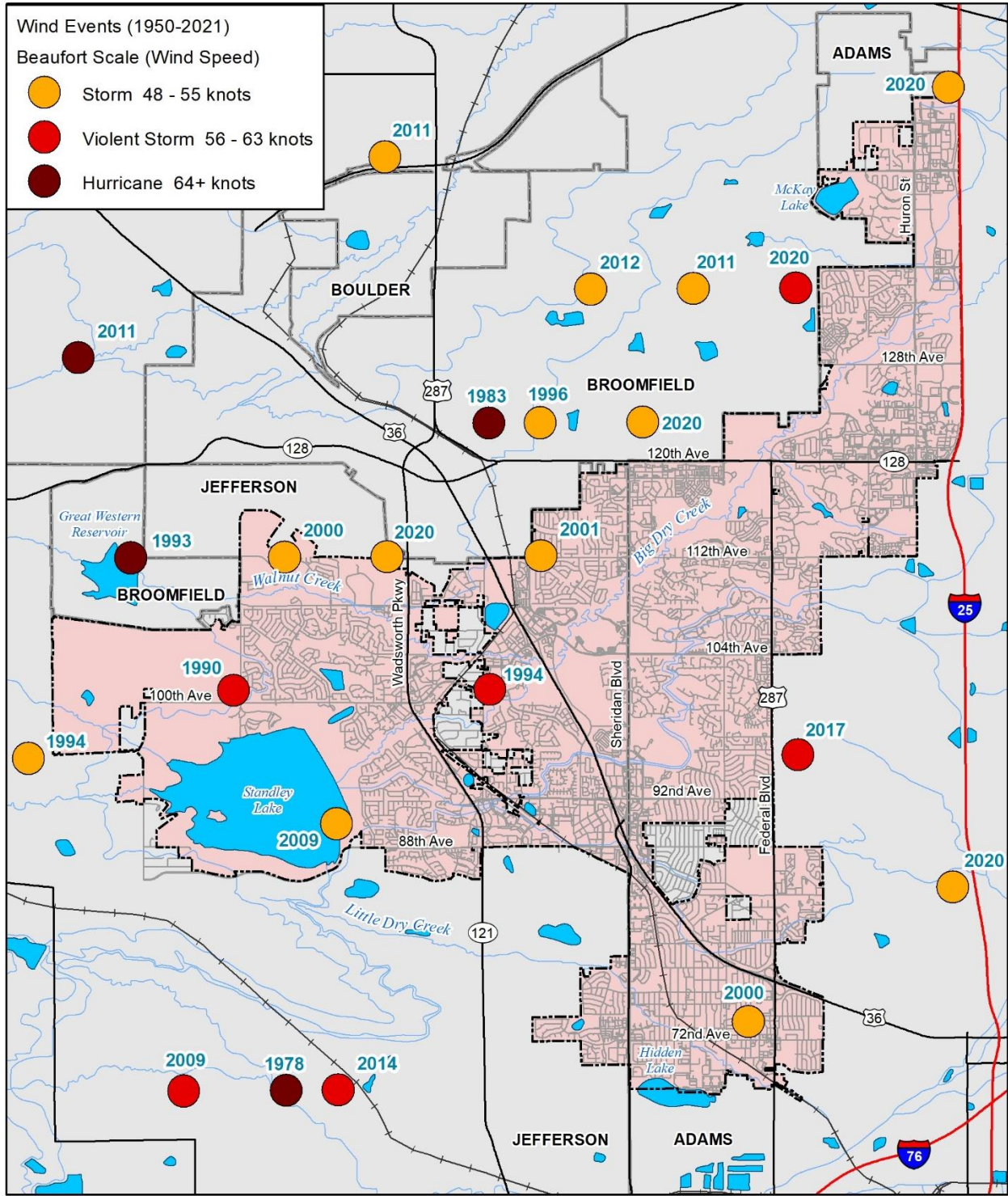
Source: NWS

Past Occurrences

Communities with the highest number of significant wind events tend to be located along the Front Range or northeast part of the state. According to the NCEI records, the Counties of Adams and Jefferson recorded 568 wind events (396 high wind, 168 thunderstorm wind, four strong wind) from 1955 to 2022. Note that high wind and strong wind data is for the years after 1996. Of these events, there were four deaths and 45 injuries reported, with damage a total of \$25,869,000 in property damage. The highest wind gust recorded in Adams and Jefferson was 133 miles per hour on November 12, 2005. Note that the NCEI database records high and strong wind hazard events on a zonal basis, therefore, data on high and strong wind events that specifically impacted the City of Westminster was not acquired. Two thunderstorm wind events specifically impacted the City of Westminster.

Figure 4-49 shows previous straight-line wind events in the city. Note that according to NOAA, straight-line winds are thunderstorm winds that have no rotation, i.e., not a tornado.

Figure 4-51 Significant Wind Events



wsp Map compiled 3/2023;
 intended for planning purposes only.
 Data Source: City of Westminster, CDOT,
 NOAA/National Weather Service, SVRGIS 2022

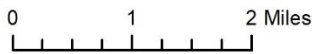


Table 4-53 Number of Days with Winds Greater or Equal to 70 mph

Number of Days with winds greater or equal to 70mph

Year	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	A	B				
Jan	2	3	1	8		4	1							7	4	1		1	2	1	3	4		1			3																			45	17		
Feb		3					1			1								3		4		1					1																					12	7
Mar	1												3	4	2		1	1			1		2																									15	8
Apr						2								1	1		2	1						2			3																					12	8
May																	2		1					1																								4	3
Jun	1						1																		1																							2	2
Jul															1																																	1	1
Aug									1				1																																			2	2
Sep																		1		1																												2	2
Oct				1		1											1					1						1																				5	5
Nov		4			1	1		2	1							1		1			1				1	1	3																				13	10	
Dec	2	2		1		2		7	3					3	4	2	1		3	2		3		2	1	1		5																			41	18	
Total	6	3		10	1		10	3	9	5	1		3	16	11	5	3	11	6	9	5	9	2	3	6	2	3	13	1	1	16	9	3	3												175	72		
Year	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	A	B				

A: Number of documented events >70mph per month
 B: Number of years with at least one day >70mph documented in month

Source: NOAA Earth System Research Laboratory, 2017

The details on a few of the most significant high wind/strong wind/thunderstorm wind events are listed below:

April 9, 1999: Damaging winds buffeted eastern Colorado, in and near the foothills from Fort Collins south to Pueblo, as well as portions of the adjacent plains. Total damages estimates were at \$13.8 million. It is likely that the City of Westminster was impacted to some extent.

December 29, 2008: Very strong Chinook winds blasted areas in and near the Front Range Foothills of Larimer, Boulder and Jefferson Counties. The wind blew down trees and power poles, downed electrical lines and fences, and damaged homes and vehicles. Scattered power outages were reported all along the Front Range. Total damages estimates were at \$7 million. It is likely that the City of Westminster was impacted to some extent.

December 20, 2004: Damaging downslope winds developed along the Front Range and spread into the adjacent plains. Two planes were damaged by debris at Jefferson County Airport. In addition, downed trees and power lines left approximately 10000 residents, mainly in the Boulder area without electricity. At least three people suffered minor injuries in the storm. Total damages estimates were at \$400,000. It is likely that the City of Westminster was impacted to some extent.

February 2, 1999: A powerful chinook windstorm struck the Front Range Foothills and adjacent plains. The damage associated with the windstorm was extensive. Thirty 70-ft tall power poles were damaged, including several that supported high voltage lines transmitting power directly from generating plants. The combination of downed power poles, power lines and trees resulted in outages for approximately 10,000 residents. The Total damage estimates for the windstorm reached \$3 million. It is likely that the City of Westminster was impacted to some extent.

Frequency/Likelihood of Occurrence

As mentioned above, the Counties of Adams and Jefferson recorded 568 wind events from 1955 to 2022, which equals to more than eight wind hazard events annually. However, since the Counties of Adams and Jefferson cover a much larger area than the City of Westminster, the likelihood of occurrence calculated based on the data of the two counties is likely to be an overestimation. Nevertheless, it can be assumed that these wind hazard events across the Counties of Adams and Jefferson are likely to have also affected the City of Westminster at some point or to some extent.

Climate Change Considerations

Ongoing research compiled in the recent climate assessment has resulted in different conclusions on the effect of climate change on wind regimes. The August 2021 IPCC report argues that in most places, wind speeds will be drastically reduced because of climate change. Meanwhile, the Maine Monitor suggests that a lack of wind can increase wildfire risks, aggravate drought, and endanger boaters. On the other hand, in 2019, Scientific American reported that winds across the world were speeding up. Unusual wind patterns combined with other climate change issues, such as hotter water temperatures, can also cause problems. At this time, these changing factors are not well understood and are still being incorporated into state and regional research and risk analysis (Garrison 2022).

Vulnerability Summary

People

The entire City is exposed to windstorm events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and power outages, while populations in low-lying areas are at risk for possible flooding.

Vulnerable populations are the elderly, low-income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a

significant concern. These populations face isolation and exposure during high winds events and could suffer the secondary effects of the hazard. Hikers and climbers in the area may also be more vulnerable to windstorm events.

Property

All property is vulnerable during windstorm events, but properties in poor condition may risk the most damage. Generally, the damage is minimal and goes unreported, however, numerous high wind, strong wind, and thunderstorm wind events have been reported in Adams and Jefferson Counties amounting to \$20,445,000 in damage over the past 68 years, which translates to approximately \$300,662 in annualized damages each year. Property located at higher elevations and on ridges may be more prone to wind damage. Property located under or near overhead lines or large trees may be damaged in the event of a collapse. Older building stock that was built according to older code standards could be highly vulnerable.

Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage. In short, all buildings are exposed to windstorm hazards while the frequency and degree of damage will depend on specific locations.

Critical Facilities

Transportation infrastructure can be affected by windstorm events, mostly associated with secondary hazards. High winds can cause significant damage to trees and power lines, blocking roads with debris and cutting off transportation access, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and the elderly. Prolonged obstruction of major routes can disrupt the shipment of goods and other commerce. Moreover, loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

Economy

Loss of power and minimal damage following a severe windstorm event could cause disruptions to the local economy through forced temporary closures of businesses and preventing people from traveling to work. More severe events could result in significant economic disruption and hinder recovery through the forced extended or permanent closure of businesses damaged in the event. Additionally, events that cause significant property damage could negatively impact the local economy. Most financial losses due to windstorms are related to direct property damages as well as subsequent debris removal, response, and repair activities.

Historical, Environmental, Cultural Resources

Historic and cultural resources are equally as exposed to severe weather events as any other infrastructure. As mentioned previously, historic infrastructure is less likely to be built to code and can be more vulnerable to damage during wind events.

The environment is highly exposed to severe winds and tornadoes. Large swaths of tree blowdowns can occur. Severe winds can trigger or spread wildfires under some conditions. Crops are also at risk of losses. The NCEI dataset reported over \$11,000 in crop losses from windstorm events in Adams and Jefferson counties.

Development Trends

Future development will be exposed to windstorm events. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. Adopting codes and land use policies that are equipped to deal with the impacts of windstorm events would prepare the City well to manage the impacts of windstorm and other severe weather events. Other protective

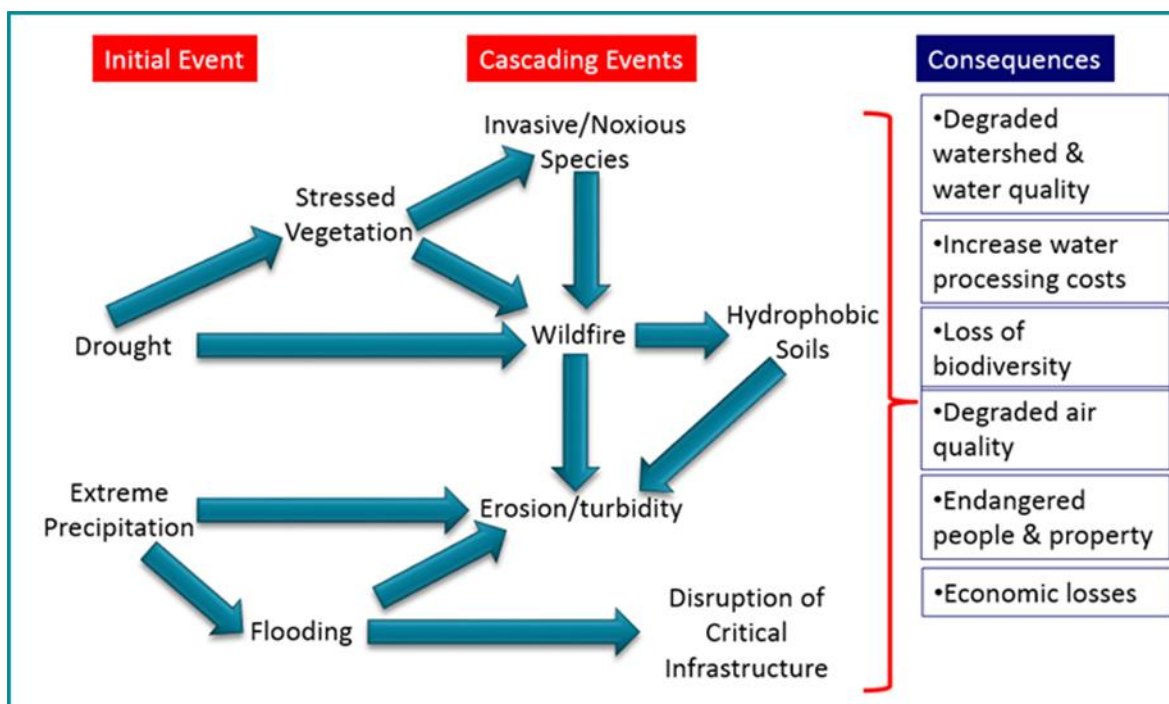
measures for both existing and future development include trimming tree limbs and securing potentially windblown possessions when not in use.

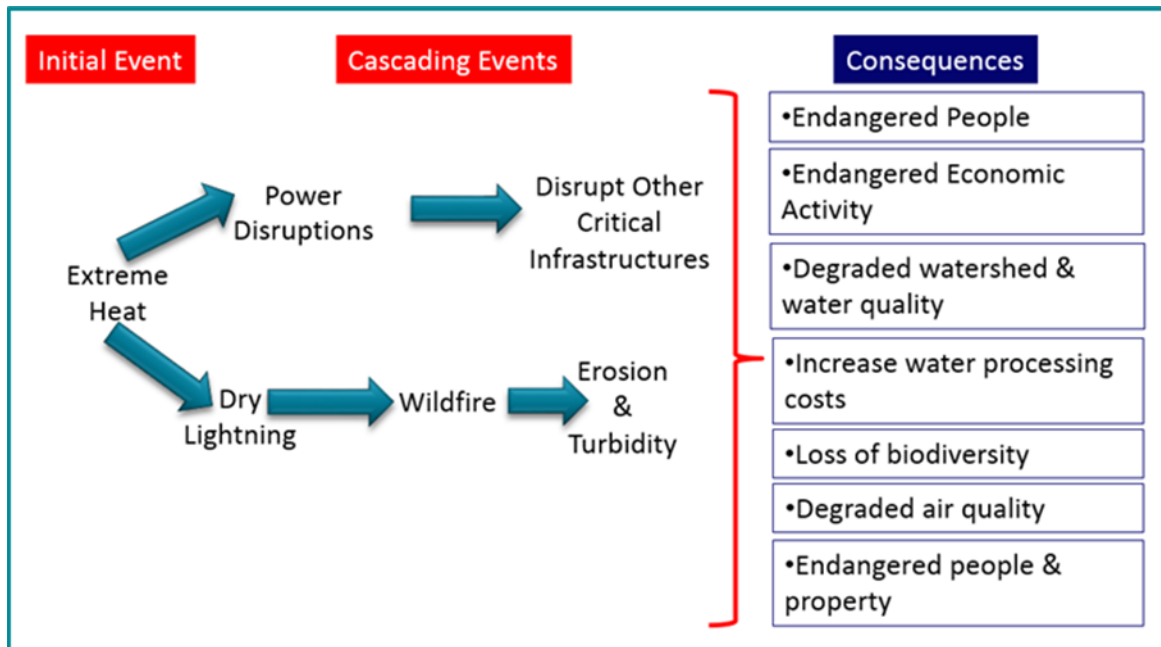
Meanwhile, continued development implies continued population growth, which raises the number of individuals potentially exposed to severe weather. Individual citizens, families, and businesses of the City need to be prepared to address severe weather events when they occur. It is recommended that citizens, families, and businesses have an emergency preparedness plan, such as storing extra supplies of food and water, as well as other related supplies such as flashlights, batteries, and firewood and have a battery-operated radio within their home or business. In addition, public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of severe weather.

4.4 Conclusion on Natural Hazards/Risk Summary

Each natural hazard is the result of unique environmental factors. While we have examined each hazard individually, it is important to remember that one hazard may lead to a cascade of other natural or human caused hazards. Hazards are complex and often related. The following are a few examples of this cascading effect and some of the consequences that may result.

Figure 4-52 Hazards Interrelationship and Cascading Events





Source: City of Westminster

The availability and quality of water is central to the natural hazard concerns of Westminster. Individual and cascading natural hazards present a complex and persistent threat to our highly vulnerable water supply. Drought and extreme rain events are high probability, high impact events. The protracted nature of drought presents major challenges to our economic activity and the existing ecosystems that characterize Westminster. Extreme rain events resulting in flooding have the potential to suddenly endanger a large number of people, damage or destroy critical infrastructure, businesses and homes, as well as damage our parks and open spaces.

Severe winter storms and blizzards are our most common meteorological hazards. While overall annual snowfall has been decreasing and winters are warmer and shorter in recent years, extreme snow and cold events are a possibility that can endanger vulnerable populations, damage critical infrastructure, impact economic activity and result in significant snow removal expenses. The impact of climate change on our meteorological hazards continues to be subject to research and analysis, but the recent trends indicate overall warming, shorter, dryer winters, early snowpack runoff and more frequent and extreme hot/cold, wet/dry events. These meteorological trends are exacerbating the environmental stress of Front Range forests, making these trees more vulnerable to various invasive species, increasing the risk of wildfire, and endangering the watershed that Front Range communities depend upon for water.

Our water supply and infrastructure are also threatened by invasive/noxious species. The pine bark beetles that are native to Colorado's forests are beginning to encroach on the Front Range watersheds and create additional stress on these critical biomes. The emerald ash borer and other invasive species are a persistent threat to our urban landscapes and biodiversity. The threat posed by zebra and quagga mussels and other invasive aquatic species demands close monitoring and stringent biosecurity measures to protect our critical infrastructure and native species.

Lightning, hail and wind each present their unique dangers to people, critical infrastructure, homes and businesses. These lesser hazards are persistent, short-duration, rapid onset events that are well understood by the public that can take protective actions in response to short-term predictions/notifications. The resulting property damage and economic disruption can be substantial.

Westminster's geological hazards include swelling soils and earthquakes. Swelling soils are common throughout the city and can result in significant damage to foundations, roads, sidewalks and pipelines.

This hazard may be exacerbated by drought and extreme precipitation events. While swelling soil does not present a potential to cause an emergency/disaster event, it is a persistent and expensive hazard that can be mitigated to lessen its impact on property owners. Westminster's vulnerability to earthquakes is limited to possible property damages and injuries due to falling objects. The proximity of several high-risk dams to small quaternary faults merits the inspection of these structures should we experience seismic activity. Although there are no active oil/gas wells within Westminster, there are significant extractive activities (including fracking) immediately north and east of the city. Colorado has a history of induced (or triggered) earthquakes and this hazard merits monitoring.

Emerging/re-emerging and resistant diseases are a perennial threat to humans, animals and plants. Improvements in public health surveillance, reporting and response have greatly reduced the threat of disease, but many pathogens (such as influenza) are constantly mutating to create new strains while other traditional diseases have developed resistance to many of antibiotics used to treat them. The rapid and continuous movement of people, animals, insects and goods globally has facilitated the rapid spread of new diseases such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), West Nile Encephalitis, Ebola and Zika. We may also see a change in the spread of diseases that are transmitted by mosquitoes and other insects as climate change influences the environments in which these vectors breed and live. Diseases that have the potential to become epidemics or pandemics will continue to challenge public health and sanitation measures.

Geomagnetic storms have been included in this risk assessment because they, like mega droughts, are rare but have potentially devastating consequences for the city and the nation. The danger posed by this hazard has grown as the critical infrastructures we depend upon have become ingrained in every aspect of our lives. As with Electromagnetic pulse (EMP), the human-caused equivalent resulting from nuclear detonations, the potential danger posed by geomagnetic storms continue to be the subject of study and debate. Although the potential national and global impact of geomagnetic storms (and EMP) goes far beyond the ability of the city to manage, it remains for us to be aware of this hazard, assess its potential impact on our critical infrastructures and implement appropriate measures to ensure local resilience.

Westminster is susceptible to numerous metrological, geological and entomological natural hazards. Many of these hazards present the possibility of triggering additional natural and human-caused hazards. Some of the hazards we have identified have the potential to profoundly affect our residents, our economy, our critical infrastructures, environment and way of life.

5 MITIGATION STRATEGY

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.

This section describes the mitigation strategy process and mitigation action plan for the City of Westminster's Hazard Mitigation Plan. It explains how the city accomplished Phase 3 of FEMA's 4-phase guidance—Develop the Mitigation Plan—and Step 6 of FEMA's 9-step planning process – Develop a Mitigation Strategy – and includes the following from the CRS 10-step planning process:

- Planning Step 6: Set Goals
- Planning Step 7: Review Possible Activities
- Planning Step 8: Draft an Action Plan

5.1 Mitigation Strategy: Overview

The results of the planning process, the risk assessment, the goal setting and the identification of mitigation actions are captured in this mitigation strategy and mitigation action plan. As part of the 2018 plan update process, a comprehensive review and update of the mitigation strategy portion of the plan was conducted by the HMPC. Some of the goals and objectives from the 2010 plan were revisited, reaffirmed and refined. The result is a mitigation strategy that reflects the updated risk assessment, progress on mitigation actions and the new priorities of this plan update. To support the updated goals, the mitigation actions from 2018 were reviewed and assessed for their value in reducing risk and vulnerability to the planning area from identified hazards and evaluated for their inclusion in this plan update (See **Section 5.4.1**). **Section 5.2** below identifies the current goals and objectives of this plan update and **Section 5.4.4** details the updated mitigation action plan.

5.2 Goals and Objectives

Requirement §201.6(c)(3)(i):

[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Up to this point in the planning process, the Hazard Mitigation Planning Committee (HMPC) has organized resources, assessed natural hazards and documented mitigation capabilities. A profile of the City of Westminster's vulnerability to natural hazards resulted from this effort, which is documented in the preceding chapter. The resulting goals, objectives and mitigation actions were developed based on this profile. The HMPC developed the new updated mitigation strategy based on a series of meetings and worksheets designed to achieve a collaborative mitigation planning effort, as described further in this section. The goals for this plan were developed and updated by the HMPC based on the plan's risk assessment. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the HMPC to update planning goals and objectives and the mitigation strategy for the City of Westminster.

Goals were defined for mitigation plan as broad-based public policy statements that:

- Represent basic desires of the community
- Encompass all aspects of community, public and private
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome
- Are future-oriented, in that they are achievable in the future
- Are time-independent, in that they are not scheduled events.

Goals are stated without regard for implementation, that is, implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that the goals are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals. Objectives define strategies to attain the goals and are more specific and measurable.

Based upon the risk assessment review and goal setting process, the HMPC developed the following goals with several objectives and associated mitigation measures. These were revisited and validated by the HMPC during the 2023 HMP update process. The only changes to the goals was to drop the word “natural” in front of “hazards.” While the focus of this HMP is on natural hazards, the City recognizes there are several human-caused threats as well. There were minor language changes to objectives 2.3 and 2.4. These updated goals and objectives provide the direction for reducing future hazard-related losses within the City of Westminster.

5.2.1 Goal 1: Increase Community Awareness of Westminster’s Vulnerability to Hazards

Objective 1.1: Inform and educate the community about the types of hazards the City of Westminster is exposed to, where they occur and recommended responses.

- Create an outreach program:
 - Provide self-help resources and training.
 - Describe mitigation alternatives.
 - Identify funding sources.

5.2.2 Goal 2: Reduce Vulnerability of People, Property, and The Environment to Hazards

Objective 2.1: Provide mechanisms to enhance life safety.

Objective 2.2: Reduce impacts to critical facilities and services.

- Identify and protect the most “critical” facilities.
- Protect hazardous materials locations.

Objective 2.3: Reduce impacts to existing buildings.

Objective 2.4: Reduce impacts to future development.

Objective 2.5: Reduce impacts to the city’s natural resources.

Objective 2.6: Reduce impacts to public health (natural health hazards, not biochemical terrorism)

5.2.3 Goal 3: Increase Internal and Interagency Capabilities and Coordination to Reduce The Impacts of Hazards

Objective 3.1: Improve planning coordination.

Objective 3.2: Improve funding coordination.

Objective 3.3: Improve response coordination.

5.3 Identification and Analysis of Mitigation Actions

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 jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

To identify and select mitigation measures to support the mitigation goals, each hazard identified in **Section 4.1: Identifying Hazards** was evaluated. Once it was determined which hazards warranted the development of specific mitigation measures, the HMPC analyzed a set of viable mitigation alternatives that would support identified goals and objectives. Each HMPC member was provided with the following list of categories of mitigation measures, which originate from the Community Rating System:

- Prevention
- Property Protection
- Structural Projects
- Natural Resource Protection
- Emergency Services
- Public Information

The HMPC members were also provided with several lists of alternative multi-hazard mitigation actions for each of the above categories (See **Appendix D** for more discussion and examples of the actions considered). A facilitated discussion then took place to examine and analyze the alternatives. With an understanding of the alternatives, a brainstorming session was conducted to generate a list of preferred mitigation actions.

5.3.1 Prioritization Process

Once the mitigation actions were identified, the HMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE sustainable disaster recovery criteria and others to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE stands for the following:

- Social: Does the measure treat people fairly? (e.g., different groups, different generations)
- Technical: Is the action technically feasible? Does it solve the problem?
- Administrative: Are there adequate staffing, funding and other capabilities to implement the project?
- Political: Who are the stakeholders? Will there be adequate political and public support for the project?
- Legal: Does the jurisdiction have the legal authority to implement the action? Is it legal?
- Economic: Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- Environmental: Does the action comply with environmental regulations? Will there be negative environmental consequences from the action? In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority. Other criteria used to assist in evaluating the benefit-cost of a mitigation action includes: Does the action address hazards or areas with the highest risk?
- Does the action protect lives?
- Does the action protect infrastructure, community assets or critical facilities?
- Does the action meet multiple objectives (Multiple Objective Management)?
- What will the action cost?
- What is the timing of available funding?

The mitigation categories, multi-hazard actions and criteria are included in Appendix D: Mitigation Categories, Alternatives and Selection Criteria.

Team members were then asked to prioritize projects with the above criteria in mind. After determining the initial hierarchy of how the actions should be ranked through discussion at the HMPC meeting, team members further discussed their reasoning for the prioritization with side-bar meetings in follow-up to the meeting. This process provided the end priority for the new mitigation actions identified in 2018. The priority levels on existing mitigation actions continuing in the plan from 2010 were also revisited using this process, and in some cases revised to reflect current priorities. The process of identification and analysis of mitigation alternatives allowed the HMPC to come to consensus and to prioritize recommended mitigation actions. During the voting process, emphasis was placed on the importance of a benefit-cost review in determining project priority; however, this was not a quantitative analysis. After completing the prioritization exercise, some team members expressed concern that prioritizing all the actions as a group is not very effective, since many of the actions are department-specific. However, the team agreed that prioritizing the actions collectively enabled the actions to be ranked in order of relative importance and helped steer the development of additional actions that meet the more important objectives while eliminating some of the actions which did not garner much support. Benefit-cost was also considered in greater detail in the development of the Mitigation Action Plan detailed below in **Section 5.4**. Specifically, each action developed for this plan contains a description of the problem and proposed project, the entity with primary responsibility for implementation, any other alternatives considered, a cost estimate, expected project benefits, potential funding sources and a schedule for implementation. Development of these project details for each action led to the determination of a High, Medium or Low priority for each.

Recognizing the limitations in prioritizing actions from multiple departments and the regulatory requirement to prioritize by benefit-cost to ensure cost-effectiveness, the HMPC decided to pursue: mitigation action strategy development and implementation according to the nature and extent of damages; the level of protection and benefits each action provides; political support; project cost; available funding; and individual jurisdiction and department priority.

This process drove the development of an updated, prioritized action plan for the City of Westminster. Cost-effectiveness will be considered in greater detail through performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this plan.

5.4 Mitigation Action Plan

Requirement §201.6(c)(3)(iii):

[The mitigation strategy shall include] an action plan describing how the actions identified in section (c)(3)(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 benefit review of the proposed projects and their associated losses.

This section outlines the development of the updated mitigation action plan. The action plan consists of specific projects, or actions, designed to meet the plan's goals. Over time the implementation of these projects will be tracked as a measure of demonstrated progress on meeting the plan's goals. If completed, these projects will help to reduce the vulnerability of property, city infrastructure and people from loss or destruction.

The HMPC and the City of Westminster also realize that if a disaster or large-scale event occurs, the priority level of these mitigation projects may change.

5.4.1 Progress on Previous Mitigation Actions

During the 2023 update process, the HMPC reviewed and evaluated the 2018 mitigation strategy to determine the status of the actions. The purpose of this was to measure progress by determining which actions were completed, and to revisit the remaining items to determine if they should be carried forward

or removed from the plan. The 2010 mitigation strategy contained 7 separate mitigation actions. Of these, two have been completed and five that are currently still in process. The actions from the 2018 plan that have been completed are shown in **Table 5.1**. The review shows that progress has been made. Implementation of the actions has resulted in greater community awareness of Westminster’s vulnerability to natural hazards and reduced vulnerability for hazards such as climate change. These actions have increased the response capabilities of the city, and thus will help save lives in future incidents. **Table 5.2** lists 16 actions from the 2018 plan being carried forward, as well as six new mitigation actions. More detailed descriptions of those actions follow. Completed Mitigation Actions from the 2018 Plan are captured below, demonstrating progress on implementation and meeting the goals of this HMP.

Table 5-1 Completed Mitigation Actions from 2018 Plan

Hazard(s)	Action Description	Status	Comments/Progress
Multi-Hazards (MH5)	Local Climate Change Awareness	Completed	For the east basin of the TOD
Flood/Stormwater – 1	Little Dry Creek Regional Detention Facility and Greenway Improvements near future Regional Transportation Department (RTD) FasTracks South Westminster Station	Completed	Community Development Department was lead.
Flood/Stormwater – 3	Impervious vs. Pervious Surface Mapping	Completed	Community Development Department conducts updates routinely.
F5	LID policy for transit-oriented development at Westminster Station	Completed	

5.4.2 Completed Mitigation Actions Not Identified in 2018

The HMPC identified several mitigation projects that have been completed since 2018 but were identified in the 2018 plan.

- Conducted a detailed review of the Open Space fire hazards and mitigation efforts following the 2021 Marshall Fire (City of Westminster Open Space Fire Risk Assessment & Mitigation March 2022). Currently promoting the NFPA’s “Firewise” principles to help residents reduce our community wind-driven fire risk.
- Addressing climate change mitigation through investments in solar energy and greenhouse gas reduction program.
- Hire of the city’s first Sustainability Officer.
- Conducted risk assessment.
- Converted open space for flood control.
- Continuous hazard awareness, mitigation and preparedness outreach using social media (Facebook).
- Development of natural hazards contact list.
- Ditch companies doing some mitigation work with post-2013 flood recovery funding.
- Documented lessons learned after 2013 floods.
- Drought Management Plan – updated through Public Works.
- Improved engagement between emergency management and the public on the HIRA.
- Improvements to the McKay Drainageway Detention Facility.
- Little Dry Creek drainage and flood control project.

- Pilot project for green infrastructure.
- Shaw Boulevard stormwater drainage project.
- Source water protection plans/call downs in case of hazmat spill or natural hazard impacts.
- Standley Lake bypass for water contamination.
- Standley Lake High School was wired with generator hook-ups with FEMA funding.

5.4.3 Continued Compliance with NFIP

Given the flood hazard and risk in the planning area and recognizing the importance of the NFIP in mitigating flood losses, an emphasis has been placed on continued compliance with the NFIP by the City of Westminster. As of May 2013, the City of Westminster was listed as a Class 6 CRS Community. As an NFIP and CRS participating community, the city has and will continue to make every effort to remain in good standing with NFIP. This includes continuing to comply with the NFIP’s standards for updating, adopting, and maintaining floodplain maps and maintain and updating the floodplain zoning ordinance. Compliance beyond the minimum NFIP standards required for Colorado NFIP participating jurisdictions include compliance with Colorado Rules and Regulations for Regulatory Floodplains (2 CCR 408-1).

There are several action items identified in Table 5-3 that address specifics related to NFIP continued compliance. Other details related to NFIP participation are discussed in the community capabilities **Section 2.6** of this plan and the flood vulnerability discussion in **Section 4.3.9**.

Other actions related to continued NFIP compliance include:

- Continued designation of a local floodplain manager whose responsibilities include reviewing floodplain development permits to ensure compliance with the local floodplain management ordinances and rules;
- Suggest changes to improve enforcement of and compliance with regulations and programs;
- Participate in Flood Insurance Rate Map updates by adopting new maps or amendments to maps;
- Utilize Digital FIRMs in conjunction with GIS to improve floodplain management, such as improved risk assessment and tracking of floodplain permits;
- Promote and disperse information on the benefits of flood insurance.

The City is in compliance with Colorado Rules and Regulations for Regulatory Floodplains (2 CCR 408-1), by adopting language in their floodplain resolutions that include the higher standards summarized in Table 5-2 below.

Table 5-2 CWCB Higher Standards for the State of Colorado

Category	State of Colorado	Minimum NFIP
Floodway [Rule 8(A)]	0.5-foot maximum surcharge*	1.0-foot maximum surcharge
Freeboard for new structures [Rule 11(B)]	Lowest floor (including basements) 1-foot above BFE	Lowest floor (including basements) at or above BFE
Required LOMR [Rule 12(H)]	Any change to BFE +/- 0.3-foot	----
LOMR-F Areas [Rule 11(C)]	Lowest floor must have 1-foot freeboard above previous BFE	Area removed from SFHA
Critical Facilities [Rule 6(D)]	Lowest floor 2-foot freeboard above BFE	No specific standards

*0.5-foot for flooding sources with no effective floodway; new/updated studies.

Source: Rules and Regulations for Regulatory Floodplains in Colorado, Dept. of Natural Resources, CWCB

5.4.4 Updated Mitigation Action Plan

A summary of the action items is captured in Table 5-3, including a description of the action priority, the year the action was first identified, the timeframe for implementation, what goals the action is linked to and the priority for the action. For each identified project, a worksheet designed to capture additional details was filled out by the HMPC member or organization taking the lead on project implementation. These details include: project background, other alternatives considered, responsible entity, priority, cost, benefits (losses avoided) and potential funding. Actions that were identified in the 2010 and 2018 plans and carried forward in this plan update also have a description of progress to date. As the city is largely built out, many of these mitigation actions are intended to reduce impacts to existing development. Actions that protect future development from hazards, as required per the DMA 2000 regulations, are addressed by the city's continued compliance with the NFIP and CRS as well as through implementation of the Westminster Municipal Code, Westminster Comprehensive Plan and building code enforcement. See the discussion in **Section 2.6.1** related to these existing policies and regulations.

Changes in priority of the action, based on the 2023 review, are reflected in the table by an asterisk, where applicable.

It is important to note that the City of Westminster has numerous existing, detailed project descriptions (including structural flood hazard mitigation and stormwater drainage projects) in other planning documents, such as the Westminster Comprehensive Plan and the Westminster Emergency Operations Plan. These projects are considered to be part of this plan, and the details, to avoid duplication, should be referenced in their original source document. Many of these studies include more detailed alternatives analysis and benefit-cost analyses. The city also realizes that new project needs and priorities may arise because of a disaster or other circumstances and reserves the right to support these projects, as necessary, as long as they conform to the overall goals of this plan.

Table 5-3 City of Westminster Mitigation Action Plan Summary

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
Multi-Hazard Actions									
MH1- Climate Change, Dam Failure, Drought & Water Security, Earthquake, Epidemic/Pandemic, Erosion, Deposition, & Turbidity, Swelling Soils, Extreme Temps, Flooding, Invasive Species, Severe Summer Storm, Severe Winter Storm, Tornado, Open Space Fire, Windstorm	Natural Hazards Public Information Booths and Outreach. The City of Westminster strives to keep its citizens and employees educated about ways that they can help protect themselves, their families, their homes and their businesses from the potential destruction that can be caused by a natural hazard event. Having information about the potential hazards, available resources and prevention information is essential for helping to mitigate the effects of a potential disaster. Information on all of the hazards profiled within the HMP will be provided	Fire Department/ Emergency Management	High	Staff Time	City of Westminster Fire Department/ Emergency Management	1,2	Annual Implementation	Continue – In Progress	Emergency management distributes hazard awareness, mitigation, and preparedness information at numerous public events throughout the year. Outreach is a City Council priority. The following is the list of events that are scheduled annually: -6 Westminster Fire Department open house events at fire stations (May through October) -Public Safety Open House -Latino Festival -Summer Block Party in historic Westminster -Water Festival in May -Westminster Harvest Festival is in October -Boo at the View around Halloween. As of late 2023 the EMC is working with the city’s two libraries on the schedule for 2024. We are planning at least one event at College Hill and evaluating topics for bi-monthly events at Irving Street Library.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
MH2 – Climate Change, Dam Failure, Drought & Water Security, Earthquake, Epidemic/Pandemic, Erosion, Deposition, & Turbidity, Swelling Soils, Extreme Temps, Flooding, Invasive Species, Severe Summer Storm, Severe Winter Storm, Tornado, Open Space Fire, Windstorm	Natural Hazards Information on Social Media. The City of Westminster strives to keep its citizens and employees educated about ways that they can help protect themselves, their families, their homes and their businesses from the potential destruction that can be caused by a natural hazard event. Having information about the potential hazards, available resources and prevention information is essential for helping to mitigate the effects of a potential disaster. This ongoing social media effort provides information on the following hazards, which were all identified as potential hazards in this plan	Fire Department/ Emergency Management	High	Staff Time	City of Westminster Fire Department/ Emergency Management	1,2	Annual Implementation	Continue – In Progress	Emergency Management posted 856 times in 2022, resulting in 21,822 public engagements. EM posted 15 HMP-update specific posts resulting in 51,001 reaches and 9,365 engagements. The EMC Facebook will continue to be used to provide almost daily information on hazards and preparedness. On average, the EMC posts 1.7 messages per day. Posts are largely driven by local weather and seasonal hazards, and annual campaigns by FEMA, Cybersecurity and Infrastructure Security Agency (CISA) and other partners. For example a post promoting the annual FEMA National Dam Safety Awareness day will occur on May 31. Facebook posts are also used to refer residents to mitigation and preparedness information on the City of Westminster website at https://www.westminsterco.gov/emergencymanagement . This site includes links to: <ul style="list-style-type: none"> •Ready.gov materials •Local emergency notification (Lookout Alert) •City of Westminster Hazard Mitigation Plan •The National Weather Service-Boulder •Colorado Department of Public Health and Environment •Xcel Energy Power Outage information •Colorado Department of Transportation road and travel information •Emergency Management Institute training information •Other local emergency management social media
MH3 – Climate Change, Dam Failure, Drought & Water Security,	Additional Awareness/Warning Systems. Westminster has relatively limited and infrequent experience with natural disasters and our large non-Colorado native population	Emergency Management	High*	\$45,000	Emergency Management Operations Budget	1,2	Annual Implementation	Continue – In Progress	Westminster recently adopted Rave Mobile Safety for public alerting and our dispatch is now IPAWS certified. Public mobile registration is about 16%.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
Earthquake, Epidemic/Pandemic, Erosion, Deposition, & Turbidity, Swelling Soils, Extreme Temps, Flooding, Invasive Species, Severe Summer Storm, Severe Winter Storm, Tornado, Open Space Fire, Windstorm	has created a lack of hazard awareness. The city currently utilizes CodeRed, but could increase awareness and warning through additional activities and systems.								
MH4 – Climate Change, Dam Failure, Drought & Water Security, Earthquake, Epidemic/Pandemic, Erosion, Deposition, & Turbidity, Swelling Soils, Extreme Temps, Flooding, Invasive Species, Severe Summer Storm, Severe Winter Storm, Tornado, Open Space Fire, Windstorm	Public Outreach in Multiple Languages. Approximately 23-percent of our population speak English as a second language. 20-percent of our residents are Hispanic and three percent are Southeast Asian. Language and cultural factors may limit the effectiveness of efforts to encourage hazard awareness, mitigation, and preparedness. This project would develop public outreach material on hazards in multiple languages to broaden hazard awareness and encourage personal responsibility for protection of life and property.	Emergency Management	Low	None	Emergency Operations budget	1,2	Annual Implementation	Continue – In Progress	<p>The city maintains a list of multilingual staff who can assist with routine translation (Spanish and Hmong) needs. The city also has procedures to request written translations and requests for professional language and American Sign Language services. Emergency management uses Spanish and Hmong language materials available on Ready.gov when possible.</p> <p>The EMC maintains copies of key Ready.gov flyers in Spanish and has shared Spanish, Hmong, and Vietnamese materials related to COVID-19 on Facebook. Spanish language materials provided through Ready.gov, the National Fire Protection Association, and vendors, are routinely included in public events and on social media.</p> <p>Support to meet translation and interpretation need are outlined in detail at https://cownet.cityofwestminster.us/OurWorkplace/BilingualCommunication/ScheduleanInterpreterorTranslation</p> <p>The City's website (westminsterco.gov) currently has</p>

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
									the ability to translate web pages in real time for the following languages: Spanish Vietnamese Hmong Laotian Russian
MH5 – Climate Change, Drought, Earthquake, Swelling Soils, Extreme Temps, Flooding, Severe Summer Storms, Severe Winter Storms, Tornado, Open Space Fire, Windstorm	New Energy and Building Code Adoption. Community Development, with assistance from the Sustainability Office, will be adopting the 2021 building and energy code updates. These codes will make new buildings safer and more energy efficient. In addition, provisions in the code will require that buildings be constructed to accommodate future installation of solar panels, batteries and electric vehicle charging stations.	Sustainability Office/Community Development / Fire Department	Medium	Low, less than \$10,000 and staff time	Operating Budgets and staff time of the Sustainability Office/Community Development/ Fire Department	1,2	Short-Term 1-2 Years	New in 2023	The adoption of the International Set of Codes (I-Codes), which includes, among others, the Building Code, the Residential Building Code, the Plumbing Code, Electrical Code, Fire Code, the Existing Building Code, and the Energy Code, all help in various fashion to mitigate several of the identified hazards. The Energy Code requires certain building materials and construction to reduce the electricity, gas, and other power used for heating and cooling homes, directly impacting climate change. The Building Code has sections addressing stabilization and construction of buildings within identified earthquake zones, engineering requirements to assess and mitigate impacts from swelling soils, and construction requirements based on storm severity within specific regions to mitigate tornado impacts, hail damage from severe storms, and also protection of structures and people from severe winter storms. The Building code also addresses wind impacts and calls out construction features based upon the regional impact zones and potential wind damage within that zone. The Fire Code is provided to ensure ongoing compliance with regulations, for instance wild land fire mitigation

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
									<p>requirements. Buildings and other facilities are kept in compliance with the sets of codes through fire inspections, which verify that the code requirements are being followed.</p> <p>Enforcement of the code will look basically the same as enforcement of the previous codes. When a developer or contractor submits plans, they are reviewed by the various code-enforcing departments in the City. These departments (building, planning, fire, engineering, etc.) all review the submittals and review them to ensure that the plans meet the various codes. Once construction or changes occur, inspections by the respective departments take place, which ensure that the submitted/approved plans are reflected in the construction. These inspections ensure compliance with the codes and the submitted, approved plans. On-going inspections of specific codes will take place through fire code enforcement.</p>
MH5 – Climate Change, Dam Failure, Drought & Water Security, Earthquake, Epidemic/Pandemic, Erosion, Deposition, & Turbidity, Swelling Soils, Extreme Temps, Flooding, Invasive Species, Severe Summer Storm, Severe	<u>Enhanced outreach to community organizations serving vulnerable populations during the next Hazard Mitigation Plan Update.</u>	Fire Department/ Emergency Management ,Westminster Inclusivity Board	Low	Fire Department Staff time	Operating Budgets and staff time of the Fire Department and other involved agencies and volunteer organizations	1,2	Medium Term 3-5 Years	New in 2023	This will include leveraging the City's Inclusivity Board at the outset of the next update of the Hazard Mitigation Plan, building on relationships with specific community groups or organizations, sharing invitations to public meetings directly with organizations representing vulnerable populations, or translating public meeting information and sharing it through platforms that would reach these groups in Westminster (see MH-4). The mission of the Inclusivity Board is to work with City Council to advocate for all voices within our community and to ensure everyone is treated with fairness, dignity, and respect. Outreach efforts will be systematically and thoroughly documented and included within the updated HMP.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
Winter Storm, Tornado, Open Space Fire, Windstorm									
Flood Actions									
F1	<p>Continued Floodplain Land Acquisition. In the past, the City of Westminster has made acquiring land that resides within the 100-year floodplain a priority for ensuring safety and reducing the risk for loss of life or property damage. However, there are still properties that have not been obtained that the City of Westminster would like to purchase in the future. Due to the sensitive nature of this project and the public availability of this plan, the City of Westminster will not release prospective property locations.</p>	Community Development	High	Land purchased at fair market value	Community Development budget	2,3	Annual Implementation	Continue – In Progress	

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
F2	<u>Continued Compliance with NFIP and Potential Improved CRS Rating.</u> A community's participation and compliance with NFIP ensures that a community manages ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters and business owners in these communities. The Community Rating System (CRS) is a way to gauge a community's compliance level and makes community with higher (better) CRS ratings eligible for insurance discounts. The City of Westminster currently stands with a CRS rating of 6. It is the goal of the city to continue to comply with NFIP standards and potentially take steps that would further improve the rating from a 6 to a 5.	Community Development	Low	Staff Time	City of Westminster, Community Development budget	2,3	Annual Implementation	Continue – In Progress	
F3	<u>Address areas needing storm sewer upgrades. Including areas identified in the Engineering Division 5-YR Capital Improvement Plan</u>	Community Development	Medium	Approximately \$7M over 2024-2028 to address priority areas identified in the CIP (see comments column).	Stormwater Utility Fund	2,3	Medium Term 3-5 Years	Continue – In Progress	Priority areas identified in the CIP include the South Hylands Creek Flood Mitigation, Big Dry Creek stabilizations, Stormwater infrastructure major repair and replacement and the Shaw Heights Tributary improvements.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
F4	Obtain Elevation Certificates for all Structures in SFHA. Elevation Certificates compare the structure elevation to the Base Flood Elevation associated with the adjacent FEMA Special Flood Hazard Area (SFHA). This information will help the city give better advice the residents on flood-proofing or mitigation measures to reduce risk to the structure.	Community Development	Low	\$100,000	Stormwater Utility Fund	2	Medium Term 3-5 Years	Continue – In Progress	
Drought Actions									
D1	Water Conservation. Colorado and the Front Range have experienced drought events throughout history. Droughts will continue to occur and the City of Westminster is committed to recognizing droughts that will affect water supply availability and to respond appropriately to these droughts.	Public Works and Utilities	Medium	Staff Time	Public Works and Utilities and Community Development budget	1,2,3	2025	Continue – In Progress	PWU views drought management planning as an ongoing process. PWU would recommend updating the City's Drought Management Plan by 2025.
D2	Turf Replacement. Multi-faceted turf replacement program to replace high-water-use turf (e.g., Kentucky bluegrass) with more water-wise landscaping. Public Works & Utilities to focus on single-family projects for front/side/back yards. Community Development to focus on large landscape projects for HOAs and office/business parks. Parks, Recreation & Libraries to focus on public projects for parks, detention ponds, and street medians.	City of Westminster: Public Works & Utilities, Community Development, and Parks, Recreation & Libraries Departments	Low	Annual spending in Medium range (\$10,000-\$100,000) with cumulative spending over multiple years in High range (\$100,000-\$1,000,000)	Operating Budgets and Capital Improvement Programs	1,2,3	Individual projects completed in Short-Term (1-2 yrs), with total program length (multiple projects) completed over Long Term (5+ yrs).	New in 2023	Multi-faceted turf replacement program to replace high-water-use turf (e.g., Kentucky bluegrass) with more water-wise landscaping. Public Works & Utilities to focus on single-family projects for front/side/back yards. Community Development to focus on large landscape projects for HOAs and office/business parks. Parks, Recreation & Libraries to focus on public projects for parks, detention ponds, and street medians.
Invasive Species Actions									

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
IS-1	Promote Water Wise and Infestation Resistant Tree Programs. Much of the urban landscape of Westminster is based on non-native trees that may require more water than native species. We are also experiencing invasive species (Emerald Ash Borer) that threatens a significant percentage of our urban trees.	Parks, Recreation and Libraries	Low	\$200k, Staff Time	Community Enhancement Program, Inflation Reduction Act funding	1,2	Annual Implementation	Continue – In Progress	Forestry's ReLeaf Westy annual tree sale continues to provide water wise and infestation resistant trees to the community. Public awareness information continues to promote this as well. Forestry was recently awarded a \$50K internal grant from the Community Enhancement Program, which will be used to plant drought tolerant, disease resistant trees in disadvantaged areas in Westminster with low tree canopy coverage. Forestry and Sustainability staff are also pursuing a \$200K grant from the Inflation Reduction Act for these same purposes. PWU-WRQ has a program to control Eurasian Milfoil in Standley Lake with weevils and PWU and PRL also have an Aquatic Nuisance Species Protocol to help protect Standley Lake from nuisance species. The protocol includes requirements that watercraft are decontaminated and prohibition of aquatic bait, among other measures.
IS-2	<u>Invasive Species Prevention.</u> Standley Lake is the city's primary water storage facility and an important recreational area for our residents. Several aquatic nuisance species have been identified as potential threats to our water supply infrastructure and native species.	Parks, Recreation and Libraries	Low	Staff Time	Staff Time of Department of Parks, Recreation and Libraries	1,2	Annual Implementation	Continue – In Progress	In response to the Emerald Ash Borer infestation, staff have launched a multimedia "Save Your Ash" public awareness campaign. Staff are actively managing the infestation on public lands and increasing involvement in private property. The open space team is also expanding Russian olive mitigation efforts throughout the city. Open Space staff also continue efforts to identify and control noxious weeds.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
IS-3	<u>Emerald Ash Borer – Tree Preservation, Removal, and Replanting.</u> Emerald Ash Borer (EAB) is the most destructive and costly invasive tree pest in North American history and is responsible for destroying hundreds of millions of ash trees. EAB is rapidly spreading throughout Westminster, 1 out of 7 trees in Westminster is an Ash; all ash trees must receive preventative treatments every 2-3 years or they will be killed by the insect. For trees on City property, the Forestry team has been assessing ash trees; ash trees that do not meet the treatment criteria must be removed, as they will eventually be killed. Removing untreated trees early temporarily slows the spread of EAB, reduces risk to tree workers, and can speed up replanting efforts by prioritizing replanting locations. The City is treating, removing, and replanting trees on City property and providing free treatment to Ash in the Right-of-Way.	Parks Recreation and Libraries – Forestry Division, Sustainability Office	High	Very High, More than \$1,000,000	Us Forest Service grants, City Forestry and Sustainability budgets, potential fundraising, other grants	1,2,3	Annual Implementation	New in 2023	Fostering of a diverse and resilient urban forest, preservation of home values and shading on residential properties, reduction in hazard of falling trees, potential reduction in invasive pests (EAB).
Open Space Fire / Wildfire / Wind-Driven Fire, Erosion, Deposition and Turbidity Actions									

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
OSF-1	<p>Clear Creek Watershed Protection and Wildfire Mitigation. Clear Creek represents 90 percent of the city's water supply and is prone to significant wildfires. Wildfire could cripple the city's ability to divert water for treatment and can produce water that current water treatment process is unable to treat.</p>	Public Works and Utilities – Water Resources & Quality Division; Clear Creek Watershed & Forest Health Partnership	High	<\$100,000/year	Water Utility Fund Operating Budget along with Federal Grant Funding; CWCB Wildfire Ready Watersheds	2,3	Annual Implementation	Continue – In Progress	Clear Creek Watershed & Forest Health Partnership's 's mission: Engage in collaborative, cross-jurisdictional planning and implementation of wildfire risk mitigation and forest health projects within the Clear Creek Watershed.
OSF-2	<p>Open Space Fire Mitigation. The city has over 3,000 acres of managed open space, much of it maintained as native grass and woodlands. These open spaces abut built environments in many areas and could present a wildfire/urban conflagration hazard during dry/drought periods and high wind events. The following are the Open Space Fire mitigation measured identified in the March 2022 Open Space Fire Risk Assessment and Mitigation study conducted by city staff:</p> <ul style="list-style-type: none"> • Maintain the 109+ miles of 10-12ft wide trails for both access and as fuel breaks for short-grass fires. • Promote Firewise USA (NFPA) community awareness through the HOAs. See NFPA - Preparing homes for wildfire. • Maintain adequate water supply and fire response resources. • Promote public awareness and understanding of Red Flag warnings. • Continue regular fuels reduction efforts on the northern and eastern edges of the WHOS. • Evaluate exposed residential fence lines for possible fuels reduction (mowing) or fuel breaks, where those actions 	Parks, Recreation and Libraries/ Open Space and Fire Department	Low	Staff Time	Staff Time and operational budgets of city departments (PRL, Fire Dept)	2,3	Annual Implementation	Continue – In Progress	Updated the action in 2023 based on the 2022 Open Space Fire Risk Assessment and Mitigation study. The fire department conducts operational resilience activities specific to open space fire mitigation, including deployment of suppression equipment based on the identified hazards. During red flag days, depending on the particular circumstances, the fire department will deploy staff on specific fire apparatus that are designed for open space or wild land fires. These apparatus are operated by trained fire personnel, many of which have advanced training and certifications for wild land operations. The two current, and an additional third unit, are/will be dispersed throughout the City into the areas of slightly higher risk, to quickly responds and address any fires. The fire department also conducts pre-fire planning in the areas to ensure available access to open space areas, to determine fuel loads, and identify hazards. The parks and open space divisions provide for additional mitigation through mowing and other operations that provide breaks in the open space areas. Some of these also include maintaining pathways, which further provide for fire breaks, as well as the trail system, which mitigate fire risk by providing breaks and areas of limited space for fire growth.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
	<p>are consistent with Open Space management objectives.</p> <ul style="list-style-type: none"> • Explore opportunities to broaden or improve the Indiana and Simms Street fuel break. • Review planning for public notifications and evacuation of limited access neighborhoods. • Pre-planning and coordination with Broomfield and Jefferson counties in the tri-jurisdiction areas. • Enforcement of fuels management in the undeveloped private land. • Install fire hydrants along the west side of Simms Street to support fire suppression in the WHOS. • Encourage residents and businesses to sign up for the Lookout Alert notification system. 								

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
OSF-3	Filter Waste to Semper Water Treatment Facility. Divert precipitation induced forest fire runoff away from Standley Lake.	Public Works and Utilities	Medium	\$3 Million	EPA Wetland Program Development Grants. CDPHE water quality grants	2	Annual Implementation	Continue – In Progress	Floating treatment wetlands (FTW) is a nature-based treatment tool that would aid the potable water treatment process in the event of watershed disasters such as the floods of 2013 or a forest fire. These types of events would release large amounts of organic and mineral matter from the soil into streams that eventually feed the canals that supply Standley Lake. This could cause huge turbidity and soluble contamination increases in the raw water supply. These would ultimately have to be removed through the treatment process and the final step in that process is filtration. The ability to FTW allows filtration treatment strategies to be developed (filter conditioning and strengthening) and tested without putting the finished water supply at risk, even if the strategy fails and the filter breaks through. SWTF has no FTW system as this was not prevalent in water treatment plants 50 years ago when SWTF was built.
OSF-4	Firewise Promotion. Promote resident awareness of the NFPA's Firewise program and the use of its guidance to reduce the risk of wind-driven fire in the urban environments. By reducing light fuels around homes and other structures, we can significantly reduce the probability of ignitions from embers showers produced by wind-driven fires.	Emergency Management Coordinator, Westminster Fire Dept. & Sustainability Officer	High	Low, Less than \$10,000 or staff time	General Fund-EMC operations budget	2	Annual/Ongoing action is implemented every year	New in 2023	Promote resident awareness of the NFPA's Firewise program and the use of its guidance to reduce the risk of wind-driven fire in the urban environments. By reducing light fuels around homes and other structures, we can significantly reduce the probability of ignitions from embers showers produced by wind-driven fires.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
OSF-5	Purchase of a Type III Wildland Vehicle. The Westminster Fire Department is purchasing a Type III brush truck to improve the response to a wildfire incident. The department currently has two Type VI units. Adding the Type III will increase the capabilities for wildfire suppression as the Type III has larger water tank and pumping capacity, and can still go "off road".	Westminster Fire Dept.	High	High, \$100,000 – \$1,000,000	City of Westminster Budget for the Westminster Fire Department	2,3	Short-Term 1-2 Years	New in 2023	Provides mitigation and suppression capabilities, enhancing the current response. Also allows for more regional assistance when necessary.
Winter Storm Actions									
WS1	Protect Water Storage Tanks from Winter Storm Damage. North Ridge Storage Tanks 1&2 are water storage tanks that are over 50 years old. Both tanks 1 and 2 have a 3-million-gallon capacity. A comprehensive tank inspection was last performed in 2012. Water tanks were drained and inspected by a certified engineer. The inspections have identified corrosion on the roof support beams. Heavy snow loads on the roofs of the storage tanks could lead to collapse of the roofs thus operational storage could be compromised.	Public Works and Utilities	Medium	\$4,600,000	City general funds, Staff time with Public Works and Utilities, US EPA Water Infrastructure Finance and Innovation Act funding; US DOI WaterSMART grants, FEMA Building Resilient Infrastructure and Communities Grants,	2,3	Annual Implementation	Continue – Not Started	The water storage tanks we have now are pretty tough. But we would need to keep access to them plowed and make sure that pump station heating systems and telemetry are working and not being allowed to freeze up.
Weather Extremes Actions									

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
WE1	<u>Become a National Weather Service StormReady Community.</u> The City of Westminster is subject to severe and extreme weather events which can endanger our residents, cause physical and economic losses and damage our environment. Becoming a National Weather Service Storm Ready Community would help raise public awareness of our weather hazards and encourage mitigation and preparedness.	Emergency Management	Low	None	Emergency Management Operations budget	1,2,3	Annual Implementation	Continue – Not Started	Becoming StormReady will also earn credits in the CRS
WE2	<u>Business Mitigation, Preparedness, and Continuity Information.</u> Our business community is vital to our economy and tax base. Natural hazards have the potential to disrupt business operations and essential services they provide to our citizens. Providing information to businesses on how they can prepare for weather extremes on their property may help with both business preparedness pre-hazard event and continuity post-hazard event.	Emergency Management with Chamber of Commerce	Low	None	Emergency Management Operations budget	2,3	Annual Implementation	Continue – In Progress	Emergency Management is developing a COOP guideline to assist city department COOP efforts. The city is active in regional cyber security and preparedness efforts and promotes COOP through the chamber of commerce and as outreach events.

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
WE3	Grid Resiliency. Solar panels in combination with battery storage can provide uninterruptible power sources during those times when the grid is disrupted. Costs of solar and batteries are dropping significantly and will soon be cost-competitive (if not already cost-competitive for certain businesses). One barrier to further adoption of solar is the lack of information and confusion over how to work with contractors. Information on solar/battery options will be promoted through the city's sustainability pages for residents and the city's Economic Development webpage for businesses.	Chief Sustainability Officer	Medium	Staff time for promotion of materials	Colorado Energy Office Public Building Electrification Grant, US Dept of Energy Grid Resilience and Innovation Partnerships (GRIP) Program; multiple financing/leasing options that currently exist for solar panels	2,3	Underway	Continue – In Progress	3rd solar group buy being offered this summer for residents of Westminster and other cities
WE4	Extreme Cold and Heat Community Support. Enhance the operational and personal resiliency of the city through planning, preparedness, warnings and communication around temporary sheltering during extreme heat and cold events, reducing potential impacts to the city's most vulnerable populations.	Emergency Management	Medium	Staff time	Staff time and operating budgets. Specific budget line of \$100,000 annually to support emergency warming shelter operations. FEMA PA funds can be used for reimbursement if part of declaration.	1,2,3	Annual implementation	New in 2023	Our primary emergency management concern for those experiencing homelessness is to provide emergency shelter during extreme cold weather events. In recognition of the danger this hazard poses to this highly vulnerable population, the City initiated emergency warmer shelters at our PRL facilities in December 2022. During the past year, the EMC has coordinated a citywide formal planning process which has included the implementation of a service contract with Bayaud Enterprises (a non-profit) to provide warming shelter staff to augment PRL staff and city volunteers. Bayaud staff and thirty City staff completed and ARC shelter operations training on November 30, 2023. Although our PRL facilities are our primary emergency shelters, the EMC has also done outreach to our local faith-based community and maintains a database of churches that have space, kitchens and showers, and are willing to potential host those experiencing homelessness. The City maintains a shelter trailer with cots and supplies for approximately 100 people. Shelter

City of Westminster Action ID	Action Description	Responsible Department/ Division	Priority	Estimated Cost	Potential Funding	Link to Goals*	Timeframe	Status 2023	Comments 2023
									<p>supplies include 2 bariatric and 2 AFN cots and other items to accommodate AFN residents. Support to meet translation and interpretation need are outlined in detail at https://cownet.cityofwestminster.us/OurWorkplace/BilingualCommunication/ScheduleanInterpreterTranslation</p> <p>Our Emergency Warning Shelter Annex also includes the role of Westminster PD co-responders who are available to assist with behavioral health issues and to help connect those in need with Community Reach and county human services.</p>

Goal 1: Increase Community Awareness of Westminster’s Vulnerability to Hazards

Goal 2: Reduce Vulnerability of People, Property, and the Environment to Hazards

Goal 3: Increase Internal and Interagency Capabilities and Coordination to Reduce the Impacts of Hazards

Table 5-4 Mitigation Actions and CRS Mitigation Categories Matrix

Mitigation Action ID	Prevention	Property Protection	Structural Protection	Natural Resource Protection	Emergency Services	Public Information
MH1						✓
MH2						✓
MH3					✓	
MH4						✓
MH5	✓	✓		✓		✓
F1	✓			✓		
F2		✓			✓	✓
F3			✓			
F4		✓	✓			
D1	✓				✓	✓
D2	✓				✓	✓
IS1		✓		✓		✓
IS2	✓			✓		
IS3	✓	✓		✓		
OSF1	✓			✓	✓	
OSF2	✓	✓		✓	✓	
OSF3	✓				✓	
OSF4	✓					✓
OSF5					✓	
WS1	✓	✓	✓			
WE1					✓	✓
WE2	✓					✓
WE3	✓	✓	✓		✓	

6 PLAN ADOPTION

Requirement §201.6(c)(5):

[The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure buy-in from the City of Westminster, raise awareness of the plan and formalize the plan's implementation. The adoption of this plan completes CRS Planning Step 9 of the 10-step planning process: **Adopt the Plan**. The governing board for the City of Westminster, the City Council, has adopted this natural hazard mitigation plan by passing a resolution. A copy of the resolution and the executed copy are included in the appendices section of this document. The plan was originally adopted on November 8, 2010. Re-adoption occurred by City Council on August 13, 2018, following the 2017-18 update of the Plan. This updated HMP will be officially re-adopted in the fall of 2023. Records of adoption and the approval packet from FEMA are documented in Appendix C. The City of Westminster will post the approved HMP, with all adoption resolutions and FEMA approval packet, to its web site within three months of FEMA approval.

7 PLAN IMPLEMENTATION AND MAINTENANCE

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.

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This is CRS Planning Step 10 of the 10-step planning process. This chapter provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

7.1 Implementation

Implementation will be accomplished by adhering to the schedules identified for each mitigation action (see **Chapter 4**) and through pervasive efforts to network and highlight the multi-objective, win-win benefits of each project to the community and its stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings and promoting a safe, sustainable community. The three main components of implementation are:

- IMPLEMENT the action plan recommendations of this plan
- UTILIZE existing rules, regulations, policies and procedures already in existence
- COMMUNICATE the hazard information collected and analyzed through this planning process so that the community better understands what can happen where, and what they can do themselves to protect their loved ones and property and be better prepared. Also, publicize the “success stories” that are achieved through the HMPC’s ongoing efforts.

An important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other city plans and mechanisms, such as the 2007 Storm Drainage Study, the Westminster Comprehensive Plan the Emergency Operations Plan and capital improvement plans and budgets. The city has and continues to implement policies and programs to reduce the loss of life and property from natural hazard events. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing projects, where possible, through these other program mechanisms.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. This integration is accomplished by constant, pervasive and energetic efforts to network, identify and highlight the multi-objective, win-win benefits to each program, the Westminster community and its stakeholders. This effort is achieved through the routine actions of monitoring agendas, attending meetings and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of city programs for coordination and multi-objective opportunities.

Simultaneous to these efforts, it is important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the costlier recommended actions. This will include creating and maintaining a bank of ideas on how any required local match requirements of state and federal grants can be met. When funding does become available, the HMPC will be able to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state or federal earmarked funds and grant programs, including those that can serve or support multi-objective applications.

7.1.1 Role of Hazard Mitigation Planning Committee in Implementation and Maintenance

With re-adoption of this plan, the Hazard Mitigation Planning Committee (HMPC) will be tasked with plan implementation and maintenance. The HMPC, led by the City of Westminster Emergency Management Coordinator agrees to:

- Act as a forum for hazard mitigation issues
- Disseminate hazard mitigation ideas and activities to all participants
- Pursue the implementation of high-priority, low/no-cost recommended actions
- Keep the concept of mitigation in the forefront of community decision-making by identifying plan recommendations when other community goals, plans and activities overlap, influences, or directly affect increased community vulnerability to disasters
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists
- Monitor and assist in implementation and update of this plan
- Report on plan progress and recommended changes to the Westminster City Council
- Inform and solicit input from the public

The HMPC will not have any powers over city staff; it will be purely an advisory body. Its primary duty is to see the plan successfully carried out and to report to the community governing board and the public on the status of plan implementation and mitigation opportunities for the city. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities and posting relevant information on the city's website and social media.

7.2 [Maintenance](#)

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks or changing circumstances are recognized

7.2.1 Maintenance Method and Monitoring Schedule

To track progress and update the mitigation strategies identified in the action plan, the HMPC Group will revisit this plan at the following times or occurrences:

- Annually, to assess if projects have been completed and to meet CRS requirements
- Following a significant hazard event
- Following a disaster declaration
- Any other time the HMPC sees it is prudent or necessary.

The City of Westminster Emergency Management Coordinator is responsible for initiating this review and will consult with members of the HMPC. This review may occur in concert with CRS review and recertification. The suggested time frame for the annual review is in the spring, prior to flood and wildfire season. This will also position the city for grant and CRS review cycles that occur in the fall. A five-year written update to be submitted to the state and FEMA Region VIII, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

This plan will be updated, approved, and adopted within a five-year cycle as per Requirement §201.6I(4)(i) of the Disaster Mitigation Action of 2000. Efforts to begin the next update should begin no later than September 2027. The city will monitor planning grant opportunities from the Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA for funds to assist with the update. This may include submitting a planning grant application. This grant should be submitted in 2024, as there is a three-year performance period to expend the funds, plus there is no guarantee that the grant will be awarded when initially submitted. This allows time to resubmit the grant in subsequent years, if needed.

Updates to this plan will follow the most current FEMA and DHSEM planning guidance. The next plan update is anticipated to be completed and reapproved by DHSEM and FEMA Region VIII by September 2028.

7.2.2 Maintenance Evaluation Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan as a measure of plan effectiveness. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions
- Increased vulnerability as a result of failed or ineffective mitigation actions
- Increased vulnerability as a result of new development (and/or annexation).

The HMPC will use the following process to evaluate progress, note changes in vulnerability and consider changes in priorities because of plan implementation:

- A representative from the responsible entity identified in each mitigation measure will be responsible for tracking and reporting to the HMPC when project status changes. The representative will provide input on whether the project as implemented meets the defined goals and objectives and is likely to be successful in reducing vulnerabilities.
- If the project does not meet identified goals and objectives, the HMPC will select alternative projects for implementation.
- New projects identified will require an individual assigned to be responsible for defining the project scope, implementing the project, monitoring the success of the project.
- Projects that were not ranked high priority but were identified as potential mitigation strategies will be reviewed as well during the monitoring and update of this plan to determine feasibility for future implementation.
- Changes will be made to the plan to accommodate projects that have failed or are not considered feasible after a review for their consistency with established criteria, the time frame, priorities, and/or funding resources.

Updates to this plan will follow the most current FEMA, DHSEM, and CRS planning guidance and consider the following:

- Consider changes in vulnerability due to project implementation
- Document success stories where mitigation efforts have proven effective
- Document areas where mitigation actions were not effective
- Document any new hazards that may arise or were previously overlooked
- Document hazard events and impacts that occurred within the five-year period
- Incorporate new capabilities or changes in capabilities
- Document continued public involvement
- Document changes to the planning process, which may include new or additional stakeholder involvement
- Incorporate growth and development-related changes to building inventories
- Incorporate new project recommendations or changes in project prioritization
- Include a public involvement process to receive public comment on the updated plan prior to submitting the updated plan to DHSEM/FEMA
- Include re-adoption by all participating entities following DHSEM/FEMA approval.

7.2.3 Incorporation Into Existing Planning Mechanisms

The mitigation strategy in **Section 5.1 Mitigation Strategy** of this plan recommends using existing plans and/or programs to implement hazard mitigation in the city, where possible. The point is also emphasized previously in this chapter. Based on this plan's capability assessment, the city has and continues to implement policies and programs to reduce losses to life and property from natural hazard events. This

plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing projects, where possible, through the following mechanisms:

- Capital improvement plans and budgets
- City Code of Regulations
- City of Westminster Comprehensive Plan
- Fire plans
- Stormwater management plans
- Sustainability planning.

At the kickoff meeting for the 2022-2023 planning process, the HMPC discussed recent studies, plans and reports with a mitigation focus that have been performed for the city. The studies or plans discussed included:

- City of Westminster Comprehensive Plan
- City of Westminster Drought Mitigation Plan
- City of Westminster Emergency Operations Plan and Management System including flood emergency procedures
- City of Westminster Sustainability Plan
- Source Water Protection Plan
- Colorado Communities for Climate Change Study
- Surrounding counties and communities' mitigation plans
 - The Thornton/Federal Heights/Northglenn Hazard Mitigation Plan
 - Adams County Hazard Mitigation Plan
 - City and County of Broomfield Hazard Mitigation Plan
 - Jefferson County Multi-Hazard Mitigation Plan
- City of Westminster Sustainability Plan (in process of being updated in 2023)
- Drainage infrastructure study (partnership with the Mile High Flood District)
- Public Works and Utilities All Hazards Risk Assessment Westminster Station Area Specific Plan
- Downtown Specific Plan
- City of Westminster Strategic Plan.

More information on these existing plans and planning mechanisms can be referenced in **Section 2.6**. HMPC members involved in the updates to these mechanisms will be responsible for integrating the findings and recommendations of this plan with these other plans, as appropriate. The mitigation plan can be considered as a “hub on the wheel” with spokes radiating out to other related planning mechanisms that will build from the information and recommendation contained herein. Since the 2018 plan was updated it has served to inform the update of the City of Westminster Emergency Plan hazards section. A concurrent effort with the 2022 update of the LHMP included the review of the city’s flood emergency procedures; the LHMP’s flood risk assessment was used to inform what will become a flood-specific annex in the city Emergency Operations Plan. The LHMP is directly cross referenced in the 2023 update of the Westminster Comprehensive Plan in several sections including topics of resilience and relevant plans.

7.2.4 Continued Public Involvement

Continued public involvement is also imperative to the overall success of the plan’s implementation. The update process provides an opportunity to publicize success stories from the plan implementation and seek additional public comment. At least one public meeting or workshop to receive public input will be held during the next update period. When the HMPC reconvenes for the update, they will coordinate with all stakeholders participating in the planning process-including those that joined the committee since the planning process began-to update and revise the plan. During the next update the City will provide targeted engagement opportunities for non-profit or other organizations that may work with underserved or

socially vulnerable populations to spread the word about this plan and messaging on hazard mitigation (see list in Table 3-6 “Other: Formal and Informal Community Organizations”). The City’s Inclusivity Board will be leveraged where feasible for inclusive and equitable outreach (see also Mitigation Action MH-6). The plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, social media and press releases to local media. Social media was a vital resource in the plan update in 2023. Using the Westminster Emergency Management Facebook page, the HMPC was able to engage thousands of residents and invite them to participate in the plan update process. Public involvement using social media will continue to be an important outreach tool for the HMPC.

Public awareness of the plan and individual flood mitigation strategies could be developed each spring prior to the beginning of runoff and flood season. This can also occur with coordination with CRS public notification activities.

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City of Westminster

Local Hazard Mitigation Plan Update 2022

Kick Off Meeting Agenda

Date: Tuesday, October 11, 2022

Time: 10:00 am – 12:00 pm MST

Webinar Link:

[Click here to join the meeting](#)

Project: City of Westminster Local Hazard Mitigation Plan and Flood Emergency Operations Plan

Subject/Purpose

The purpose of the meeting is to initiate the process for updating the City of Westminster Hazard Mitigation Plan (HMP) and introduce the requirements and schedule. The HMP is intended to identify hazards, assets at risk, and ways to reduce impacts through long-term sustainable mitigation projects. The HMP is required to be updated every 5 years. Another component in parallel to the HMP is the development of a Flood Emergency Operations Plan.

Attendees: Hazard Mitigation Planning Team and Stakeholders

1. Introductions
2. Hazard Mitigation Overview
3. Mitigation Planning Process and Requirements
4. Flood Emergency Operations Plan Overview
5. Hazard Mitigation Planning Team and Stakeholders Roles and Responsibilities
6. Planning for Public Involvement
7. Coordination with Other Agencies and Related Planning Efforts
8. Hazard Identification Review
9. Information Needs/Next Steps
10. Questions and Answers



City of Westminster, Colorado
Hazard Mitigation Plan 2022-2023 Update & Flood Emergency
Operation Plan

Kick-Off Meeting Summary
Tuesday, October 11, 2022
10:00 am – 12:00 pm MST
 Microsoft Teams Meeting

Introductions

This document summarizes the kickoff meeting for the City of Westminster Hazard Mitigation Plan (HMP) update in 2022 and flood Emergency Operation Plan (EOP). The meeting was facilitated by Jeff Brislawn with WSP (formally known as Wood Environment & Infrastructure Solutions, Inc.) via Microsoft Teams, with members of the Hazard Mitigation Planning Committee (HMPC) in attendance. WSP serves as the consulting firm working under a contract with the City of Westminster to facilitate the planning process and develop the updated HMP for the city.

Greg Moser, Emergency Management Coordinator with the City of Westminster, began the meeting with a brief introduction of the plan update. Greg noted that the previous plan was adopted in 2018 and is due for an update to comply with the 5-year update requirement by FEMA. Greg emphasized the importance of maintaining a current Hazard Mitigation Plan (HMP), which is necessary for jurisdictions who seek FEMA grant funding before or after disasters. Greg then turned the meeting over to Jeff Brislawn, Project Manager with WSP, who asked those attending to introduce themselves by stating their name, title, and agency/jurisdiction. Twenty-one (21) persons representing a mix of city departments and stakeholders were present for the meeting.

Name	Title	Jurisdiction
Amanda Martinez	City of Westminster	GIS Specialist
Andrea Song	City of Westminster	Utilities Operations Division Manager and Acting Engineering Division Manager
Andrew Hawthorn	City of Westminster	Stormwater Utility Administrator
Bob Hose	Westminster Fire Department	Deputy Chief
Bob Krugmire	City of Westminster	Water Resources Engineer
Bridger Tomlin	City of Westminster	Sustainability Associate
Bruce Rindahl	MHFD	Flood Warning Manager
Christopher Johnson	WSP	Hazard Mitigation Planner
Greg Moser	City of Westminster	Emergency Management Coordinator

Heather Otterstetter	City of Westminster	Stormwater Coordinator
Irene Merrifield	CODHSEM	Mitigation Planner
Jeff Brislawn	WSP	Project Manager
Josh Nims	City of Westminster	Interim Water Resources and Quality Division Manager
Kit Redmer	City of Westminster	Community Outreach Liaison
Kurt Muehle Meyer	City of Westminster	Street Operations Manager
Mack Chambers	WSP	GIS Analyst
Mikeal Parlow	City of Westminster	Policy and Budget Coordinator
Natalie Schoen	WSP	Hazard Mitigation Planner
Paul Schmiechen	City of Westminster	Chief Sustainability Officer
Seth Plas	City of Westminster	Capital Projects Administrator
Shelby Wood	City of Westminster	Senior Business Resource Management Analyst

Jeff thanked everyone for attending the meeting. Jeff served as the Project Manager on the previous HMP for the City of Westminster and has worked with some of the same people who will be assisting with the 2022 HMP update. Jeff also explained that a flood Emergency Management Plan will be developed in coordination with the HMP. Jeff emphasized the importance of jurisdiction participation throughout the planning process and explained that Greg Moser will be the lead point of contact for the Hazard Mitigation Planning Committee (HMPC). Jeff mentioned that Mack Chambers, GIS Specialist with WSP, may also be in contact with the HMPC for data collection for the project.

Following introductions, Jeff asked the group how many of them participated in the 2018 HMP planning process, to which 38% of the group answered yes and 62% answered no. Jeff then discussed the agenda items; the key discussion is summarized below, and additional details are within the meeting PowerPoint presentation. An interactive web-based tool called Slido was used to collect responses from members of the HMPC. The results of the Slido polls are included in this meeting summary.

Hazard Mitigation Overview (Colorado DHSEM)

Irene Merrifield, Mitigation Planner with Colorado Division of Homeland Security & Emergency management (DHSEM), gave a presentation on the concept of hazard mitigation planning and its importance. Irene explained that mitigation is defined as any sustained action taken to reduce or eliminate long-term risk to human life and property from natural or human-caused hazards. Mitigation Planning guides mitigation activities in a coordinated and economic manner to make communities more disaster resilient. An example of a hazard mitigation strategy is the practice of elevating homes located near a river, so the house stays above rising water during a flooding event and therefore minimizes damages to the home. The FEMA definition of mitigation does not include purchasing emergency vehicles or radios for communication, because those resources would be used to respond to a disaster, not prevent one. Irene

highlighted that a typical example of a mitigation project would be to create defensible spaces by removing vegetation around houses to reduce losses from wildfires.

Irene explained the U.S. Disaster Mitigation Act of 2000 requires state and local governments to adopt a hazard mitigation plan, updated every 5 years, to maintain eligibility for pre- and post-disaster FEMA mitigation assistance grants. Irene stated there are two main types of benefits a community gain from having a FEMA approved hazard mitigation plan (HMP); (1) the planning process is a great way to collaborate with other jurisdictions in the community; (2) having an HMP approved by FEMA makes a community eligible for FEMA grants (Hazard Mitigation Assistance Pre-Disaster, Flood Mitigation Assistance, Hazard Mitigation Grant Program-Post-Disaster). She noted that any funding requests from FEMA need to be based on the hazards and mitigation strategy in the HMP. She added that information from the HMP, specifically the vulnerability assessment and mitigation strategy, can be used in other hazard related plans such as an Emergency Operations Plan or Community Wildfire Protection Plan.

There are trends resulting in increased costs for disaster response and recovery related to population growth and the increase in the types of events we experience as a community. Irene explained we need these plans for several reasons because they reduce future recovery costs, we can plan around predictive events, and they guide mitigation activities in a coordinated manner. Additionally, mitigation efforts are economically beneficial. Irene displayed a slide with a nationwide average benefit-cost ratio by hazard and mitigation measure. It was found that, on average, for every \$1 spent on mitigation, an average of \$6 is saved during disaster response. Irene also shared a slide with hazard mitigation projects in Colorado since 2011, which showed that since 2011, 166 mitigation projects have been conducted and total FEMA funding and local match has totaled over \$152 million.

Irene concluded the section by emphasizing that the HMP is not a regulatory document and there is no penalty for jurisdictions who are not able to meet all the hazard mitigation actions and goals. Rather, this plan is used to outline the goals and actions that help communities better reduce impacts of future disaster events

Hazard Mitigation Planning Process and Requirements

Jeff continued the meeting with the specific planning requirements the city will have to meet to have a FEMA approved plan. Jeff explained that the City of Westminster Hazard Mitigation Plan (HMP) will be updated in accordance with the Disaster Mitigation Act (DMA) requirements. Jeff reviewed the original 4 phase FEMA planning process approach and explained that we are in phase one, quickly moving to phase two:

1. **Organize Resources:** Jeff described that the first phase in the approach is a commitment from jurisdictions to participate in planning and determine the planning team. Jeff emphasized that local input and participation from HMPC members is required for full FEMA approval. Stakeholders include other local, state, and federal agencies with a stake in hazard mitigation in the city or may include academic institutions, local business, and industry. Neighboring jurisdictions are also considered stakeholders (*see Hazard Mitigation Planning Team and Stakeholders Roles and Responsibilities, Planning for Public Involvement, and Coordination with Other Agencies and Related Planning Efforts Sections*).

2. **Risk Assessment:** Jeff explained that the hazard identification and risk assessment (HIRA) is used to describe hazards, identify community assets, analyze risk based on gaps in assets, and summarize vulnerability. The risk assessment for the City of Westminster will be conducted by WSP with input from the HMPC, stakeholders, and the public. Conducting a risk assessment is a key aspect of a hazard mitigation plan and involves two components; hazard identification (what can happen here) and the vulnerability assessment (what will be affected). The HMP update will be based on existing documents and studies, with the previous City of Westminster Hazard Mitigation Plan (2018) providing the baseline for identified hazards and the groundwork for goals, policies, and actions for hazard mitigation. Data on hazards from the past 5 years will be used to conduct the risk assessment, using sources such as GIS-based maps, historic records, insurance data, etc. Members of the HMPC and the public will ground truth this data to ensure the HMP is accurate and to maximize the utility of the document. The 7 community lifelines will be used to organize community assets and then a vulnerability assessment will be conducted to identify infrastructure and groups of people who will be more likely to experience losses (*see Hazard Identification Review Section*).

3. **Develop a Mitigation Plan:** Jeff continued to explain that the third step consists of reviewing goals and objectives from the 2018 City of Westminster HMP, reviewing mitigation alternatives to expand or improve previous goals, and then drafting an action plan (*see Mitigation Strategy Update Overview Section below*).

4. **Adoption and Implementation:** Jeff explained that once the plan is officially adopted, the designated project manager for each participating jurisdiction will integrate the plan into existing structures and track progress of the mitigation actions (*see Adoption and Implementation Section below*).

Hazard Mitigation Planning Team and Stakeholders Roles and Responsibilities

Jeff continued to emphasize the importance of all jurisdictions staying involved in the planning process to get full FEMA approval of the HMP and ensure that the plan is suited to local needs. The role of the HMPC is to provide accurate information and contribute ideas that will ensure the HMP is a useful document. The HMPC is composed of city departments and governments, such as public works & utilities, finance, economic development, fire department, etc. In addition to City of Westminster departments, other stakeholders in the public, private, and non-profit sectors are encouraged to be members of the HMPC.

Jeff informed the group that WSP would work in collaboration with the attendees of the kickoff meeting to create a robust list of stakeholders that should be involved with the HMPC, and an email list will be created to update these stakeholders on meeting times and places. Jeff presented several slides with information on possible local, state, and federal stakeholders that should be included in the HMPC. He then used a Slido poll to ask the group what other stakeholders should be included in the planning process. Responses include:

- National Weather Service
- Colorado Office of Emergency Management
- Chamber of Commerce
- National Response Center
- Nearby Hospitals

- Business groups
- Colorado Department of Public Health and Environment
- Media
- Homeowners Associations
- Schools
- Ditch companies

Greg Moser asked that all members of the HMPC with contact information of stakeholders send the information to him so they can begin coordination, especially stakeholders at a local level. Kit Redmer, Community Outreach Liaison with the City of Westminster, mentioned that he has connections with the HOA's in the city and can communicate information through existing networks. Jeff noted that WSP has a network of connections at the state and federal level that will be invited to following meetings. Jeff explained participation requirements for the HMPC and stakeholders. Stakeholders are potentially interested representative or groups that may not be City staff. Participation includes the following for the **Hazard Mitigation Planning Committee (HMPC) members:**

- Attend meetings and participate in the planning process
- Provide requested information to update or develop jurisdictional information
- Provide status of previous mitigation projects
- Identify new mitigation projects
- Review drafts and provide comments
- Assist with and participate in the public input process
- Track your time for local match purposes

Participation for **stakeholders:**

- Attend HMPC meetings or stay in loop via email list
- Provide data/information
- Partner on mitigation efforts
- Review and comment draft plan

Planning for Public Involvement

Jeff noted that an online survey will be developed to gather input from the public on hazard concerns and mitigation ideas. It is advantageous to involve the public in the planning process to strengthen local support for the plan and ensure that the mitigation actions outlined in the HMP will better suit local needs. A short online survey that takes less than 5 minutes to complete will be developed during the effort. The URL for the survey will be sent to the HMPC to be advertised to community members through public information channels, official websites, social media, email blasts, etc. Jeff emphasized the importance of the public outreach to find the gaps between what the experts think and what the community perceives as risk.

The group was asked about upcoming opportunities for outreach at scheduled public meetings or events. The responses include:

- Earth Day activities
- Westy Fest in October
- Great Global Cleanup lunch in April

- Neighborhood outreach in first, second, and third quarter 2023
- Parks and Rec Community
- Community BBQs
- February and April presentations on flood and drought
- Irving Street Playground event on November 16
- Ditch Company annual meetings

Greg mentioned that he is doing a series of presentations in the library each month about hazards, which is a good opportunity for community outreach regarding the HMP update. Kit asked if WSP provides an email template that can be sent out to the HMPC, to which Jeff responded that WSP will send the HMPC members a one-sheeter with information for public outreach. Greg noted that he would like to have scheduled meetings going forward for community outreach so that the plan continued to be used rather than sit on the shelf.

Coordination with Other Agencies and Related Planning Efforts

Jeff then facilitated a discussion on recent studies of hazards in other documents and reports that are related to the City of Westminster HMP. Jeff again emphasized the importance of integrating the updated HMP into other plans and vice versa to ensure the plan is being used effectively. Jeff displayed a slide with a list of related planning efforts that could be used as references for this HMP. The group was asked if there are any other existing plans, reports, or studies that should be reviewed for this planning process. The responses include:

- 2024 budget process
- Adams and/or Jefferson Counties
- Emergency Action Plans of State and Local Dams
- Sustainability Plan
- Power Workers Union (PWU) Emergency Response Plan 2022
- Heat/air quality information

Amanda Martinez, GIS Specialist with the City of Westminster, and Greg will work together to get flood mapping data to WSP. Jeff mentioned that a GIS needs list will be developed by WSP and sent to the HMPC. The most recent flood layers will be on the GIS needs list.

Hazard Identification Review

Based on hazards from the 2018 City of Westminster HMP, the list of potential hazards was reviewed. Jeff showed a slide that listed the hazards in the 2018 HMP and the significance ranking for each hazard.

- Climate Change
- Drought and Water Security
- Earthquake
- Epidemic/Pandemic
- Erosion, Deposition and Turbidity
- Expansive Soil
- Extreme Cold

- Extreme Heat
- Flooding
- Dam Failure
- Hail
- Invasive and Noxious Species
- Lightning
- Severe Summer Storm
- Severe Winter Storms/Blizzards
- Solar/Geomagnetic Storm
- Tornado
- Open Space Fire (Wildfire)
- Windstorm

The group discussed what other hazards should be considered that were not included in the 2018 plan. The responses are as follows:

- Failure of critical infrastructure
- Air quality events (ozone and wildfire smoke)
- Industrial facilities, like fertilizer place that caught fire a few years ago
- Failure of treatment plans
- Cip failure
- Civil Unrest
- Cybersecurity and infrastructure failure
- Cyber-attack/cyberthreat
- Tree die-off (Emerald Ash Borer)
- Wind driven fire, urban conflagration
- Weapons of mass destruction
- Human threat: nuclear disaster/bomb threat
- Chemical hazards in the community (Greg has information on this)
- Active shooter
- Rocky Flats fire and water contamination

Greg mentioned that wind driven fire should be a separate hazard from the open-space fire hazard. Additionally, Greg, Kit, and the Chief Sustainability Officer, Paul Schmeichel, noted that poor air quality and extreme heat hazards need to be listed as hazards due to the increasing frequency in events. Jeff explained that “dam failure” will be changed to “dam incidents” to include events such as flooding during low dams that aren’t necessarily associated with a dam failure. Jeff also noted that cyber-attacks are commonly added to HMPs and reminded the group that the hazards added to the HMP need to be realistic to mitigate. The group then discussed what growth and development trends in the past 5 years may have increased or decreased vulnerability to hazards, such as floodplain development. Responses include:

- Increased urban sprawl in the front range—decreased open land
- Multifamily homes
- Supply chain issues in the event of a disaster
- Home proximity

Mitigation Strategy Update Overview

Jeff then reviewed the goals and mitigation actions from the 2018 City of Westminster HMP. There are 20 total mitigation actions from the 2018 HMP. Jeff displayed a slide with all mitigation actions listed from the 2018 plan and explained that the city will need to provide status of all actions from the 2018 plan. The goals from the 2018 HMP are as follows and will be revisited in a future meeting to discuss if modifications are needed:

- Goal 1: Increase Community Awareness of Westminster’s Vulnerability to Natural Hazards
 - Objective 1.1: Inform and educate the community about the types of hazards the City of Westminster is exposed to, where they occur and recommended responses
- Goal 2: Reduce Vulnerability of People, Property, and the Environment to Natural Hazards
 - Objective 2.1: Provide mechanisms to enhance life safety
 - Objective 2.2: Reduce impacts to critical facilities and services
 - Objective 2.3: Reduce impacts to existing buildings to the extent possible
 - Objective 2.4: Reduce impacts to future development to the extent possible
 - Objective 2.5: Reduce impacts to the city’s natural resources
 - Objective 2.6: Reduce impacts to public health (natural health hazards, not biochemical terrorism)
- Goal 3: Increase Internal and Interagency Capabilities and Coordination to Reduce the Impacts of Natural Hazards
 - Objective 3.1: Improve planning coordination
 - Objective 3.2: Improve funding coordination
 - Objective 3.3: Improve response coordination

Adoption and Implementation

Jeff explained that four drafts of the updated plan will be created before adoption and implementation. First the draft for internal review by the HMPC, then the draft for public review, followed by the draft for state review, and finally the draft for FEMA review. Once FEMA reviews the draft and approves, adoption and implementation of the plan can begin. The implementation of the plan consists of assigning a project manager that will integrate mitigation actions into other plans and mechanisms in the city. Additionally, the project manager and team will work to track progress of mitigation actions, monitor changes in vulnerability, and report on progress and successes to the public. Greg would like to implement a plan for regularly scheduled meetings with the public to maintain implementation of the plan.

Flood Emergency Management Plan Overview

Jeff explained that in addition to the HMP update for the City of Westminster, WSP in conjunction with the city will be developing a flood Emergency Operations Plan (EOP). The flood EOP will be developed to support the existing City EOP and will align with the Community Rating System to potentially earn credits. Jeff outlined the tasks for the flood EOP development:

- Task 1: Review, Revise and Develop Flood Threat Analysis and Mapping
- Task 2: Develop Early Flood Threat Warning Criteria
- Task 3: Develop Flood Response Plan Responsibilities for the Floodplain Administrator

- Task 4: Quantify FEMA CRS Points for Flood Warning and Response Actions and Recommend Future Actions

Information Needs/Next Steps

Jeff (WSP) concluded the meeting by discussing the next steps in the planning process. Jeff explained that the HMP will be updated over the next nine months, with at least two more meetings with the HMPC and a predicted final approval date for the HMP by July 2023. WSP will be updating the Hazard Identification and Risk Assessment (HIRA) in the next couple of months, with input from the HMPC. An outline of anticipated dates for each task can be found below.

Tasks	Dates
B.1 Hazard Mitigation Plan Update	
Task 1: Organize Resources	Contract approval assumed June 2022; June – August 2022
Task 2: Hazard Identification and Risk Assessment	Sept-Nov 2022
Task 3: Develop a Mitigation Strategy	Dec 2022 - Feb 2023
Task 4: Plan Adoption, Monitoring, & Evaluation	March – July 2023; DHSEM submittal April; FEMA approval anticipated June; Local Adoption assumed in July
Task 5 Grant Management and Lifecycle Cost Analysis	June 2022-July 2023 as needed; lifecycle analysis Dec 2022-Feb 2023
B.2 Flood Emergency Operations Plan and FEMA Related Community Rating System Analysis	
Task 1: Review, Revise and Develop Flood Threat Analysis and Mapping	Aug-Nov 2022
Task 2: Develop Early Flood Threat Warning Criteria	Dec 2022
Task 3: Develop Flood Response Plan Responsibilities for the Floodplain Administrator	Jan-Feb 2023
Task 4: Quantify FEMA CRS Points for Flood Warning and Response Actions and Recommend Future Actions	March-April 2023

Jeff discussed a slide with initial information needs and next steps. Jeff encouraged the group to send by email information on:

- Recent hazard events (since 2018) – damages, incident logs, damage assessments, etc.
- Growth and development trends
- Critical assets and vulnerabilities
- Capability assessment
- Status of actions from previous plan
- Latest GIS data

A Plan Update Guide will be sent to solicit updated information on specific aspects of the plan at a future date. The public survey, when available, should be shared as broadly as possible.

Greg Moser reviewed his action item list, which included:

- Collect stakeholder contact information
- Send open space study to Jeff from last spring
- Add people to contact lists for future meeting

- Add flame chart for human caused hazards
- Send link to previous HMP out to everyone
(<https://www.cityofwestminster.us/Portals/1/Documents/Public%20Safety%20-%20Documents/Emergency%20Management/Westminster%202018%20HMP%20Update-Final%20Aug%202018.pdf?ver=2018-10-10-102858-093>)
- Push out Plan Update Guides to HMPC
- Send link for public survey once available

WSP will begin work on the Hazard Identification and Risk Assessment update and develop a public survey that can be used online. The next HMPC meeting will be following the update of the Hazard Identification and Risk Assessment section of the plan. The specific date will be shared when available.

Jeff Brislawn (WSP) and Greg Moser (City of Westminster) ended the meeting by thanking everyone for their attendance and active participation throughout the meeting.

Adjourn

Meeting adjourned at 11:50 p.m.

Chat log

Meeting chat

Message List

Profile picture of Krugmire, Bob. Bob Krugmire, Water Resources Engineer, Cit... by Krugmire, Bob Krugmire, Bob (External) 9:59 AM

Bob Krugmire, Water Resources Engineer, City of Westminster

Profile picture of Parlow, Mikeal. Mikeal Parlow, Policy and Budget Coordinato... by Parlow, Mikeal Parlow, Mikeal (External) 9:59 AM

Mikeal Parlow, Policy and Budget Coordinator, City of Westminster

Profile picture of Bruce Rindahl. Bruce Rindahl, Flood Warning Manager, MHFD by Bruce Rindahl Bruce Rindahl 9:59 AM

Bruce Rindahl, Flood Warning Manager, MHFD

Profile picture of Plas, Seth. Seth Plas, Capital Projects Administrator, ... by Plas, Seth Plas, Seth (External) 10:01 AM

Seth Plas, Capital Projects Administrator, City of Westminster

Profile picture of Johnson, Christopher A. Christopher Johnson, Hazard Mitigation Plan... by Johnson, Christopher A

Johnson, Christopher A 10:01 AM

Christopher Johnson, Hazard Mitigation Planner, WSP

Profile picture of Wood, Shelby. Shelby Wood, Senior Business Resource Manag... by Wood, Shelby Wood, Shelby (External) 10:02 AM

Shelby Wood, Senior Business Resource Management Analyst, City of Westminster

Profile picture of Martinez, Amanda. Amanda Martinez, GIS specialist, City of We... by Martinez, Amanda Martinez, Amanda (External) 10:03 AM

Amanda Martinez, GIS specialist, City of Westminster

Profile picture of Tomlin, Bridger. Bridger Tomlin, Sustainability Associate, C... by Tomlin, Bridger Tomlin, Bridger (External) 10:03 AM

Bridger Tomlin, Sustainability Associate, City of Westminster

Profile picture of Hawthorn, Andrew. Andrew Hawthorn, Stormwater Utility Adminis... by Hawthorn, Andrew

Hawthorn, Andrew (External) 10:03 AM

Andrew Hawthorn, Stormwater Utility Administrator, City of Westminster

Recording has started

10:03 AM Recording has started

Profile picture of Otterstetter, Heather.Heather Otterstetter, Stormwater Coordinato... by Otterstetter, Heather
Otterstetter, Heather (External)10:04 AM
Heather Otterstetter, Stormwater Coordinator, City of Westminster

Profile picture of Schmiechen, Paul.Paul Schmiechen, Chief Sustainability Offic... by Schmiechen, Paul
Schmiechen, Paul (External)10:04 AM
Paul Schmiechen, Chief Sustainability Officer, City of Westminster

Profile picture of Redmer, Kit.Kit Redmer, Community Outreach Liaison, Cit... by Redmer, Kit
Redmer, Kit (External)10:04 AM
Kit Redmer, Community Outreach Liaison, City of Westminster

Profile picture of Moser, Greg.Greg Moser, Westminster EMC by Moser, Greg
Moser, Greg (External)10:04 AM
Greg Moser, Westminster EMC

Profile picture of Song, Andrea.Andrea Song, Utilities Operations Division ... by Song, Andrea
Song, Andrea (External)10:04 AM
Andrea Song, Utilities Operations Division Manager and Acting Engineering Division Manager

Profile picture of Nims, Josh.Josh Nims, Interim Water Resources and Qual... by Nims, Josh
Nims, Josh (External)10:05 AM
Josh Nims, Interim Water Resources and Quality Division Manager, City of Westminster

Profile picture of Schoen, Natalie.Natalie Schoen, hazard mitigation planner, ... by Schoen, Natalie
Schoen, Natalie10:06 AM
Natalie Schoen, hazard mitigation planner, WSP

Profile picture of Tomlin, Bridger.Same-site says cant be reached by Tomlin, Bridger
Tomlin, Bridger (External)10:07 AM
Same-site says cant be reached

Profile picture of Hose, Bob.Bob Hose, Deputy Chief, Westminster Fire De... by Hose, Bob
Hose, Bob (External)10:17 AM
Bob Hose, Deputy Chief, Westminster Fire Department

Profile picture of Otterstetter, Heather.Might be good to have something at the Grea... by Otterstetter, Heather
Otterstetter, Heather (External)10:50 AM
Might be good to have something at the Great Global Cleanup lunch in April

City of Westminster

Local Hazard Mitigation Plan Update

Risk Assessment Meeting Agenda

Date: Wednesday, February 22nd, 2023

Time: 10:00 am – 12:00 pm MST

Location: Virtual/MS Teams

Teams Meeting Link:

Join on your computer, mobile app or room device

[Click here to join the meeting](#)

Project: City of Westminster Local Hazard Mitigation Plan and Flood Emergency Operations Plan

Subject/Purpose

The purpose of the meeting is to review the highlights of the risk assessment for natural hazards profiled in the update of the City of Westminster Hazard Mitigation Plan (HMP). We will also review the plan's Goals and Objectives.

Attendees: Hazard Mitigation Planning Team and Stakeholders

1. Introductions
2. Review of the Mitigation Planning Process
3. Update on Public Involvement Activities
4. Hazard Identification and Risk Assessment Update Review and Highlights
5. Capability Assessment Update
6. Goals Review and Mitigation Strategy Update Needs
7. Next Steps
8. Questions and Answers





City of Westminster, Colorado
2023 Local Hazard Mitigation Plan Update
Risk Assessment Meeting Summary
February 22, 2023; 9:30-11:30 am MST

Purpose

This document summarizes the risk assessment meeting held for the City of Westminster Local Hazard Mitigation Plan (HMP) 2023 update. The meeting was conducted by WSP (formally Wood Environment & Infrastructure Solutions), the consultant firm hired to facilitate the planning process and develop the updated plan. The purpose of the meeting was to review the highlights of the updated Hazard Identification and Risk Assessment and revisit the plan's goals. This meeting was delivered as a virtual web meeting via Zoom. Jeff Brislawn, Project Manager at WSP, began the meeting with introductions. 14 individuals attended the meeting representing a mix of the consultant team, city department representatives, and various stakeholders. Slido Polls, an interactive, web-based tool, was used to receive feedback from the planning committee. Responses to the poll are incorporated into this meeting summary.

Attendees

1. Andrew Hawthorn, Stormwater Utility Manager, City of Westminster
2. Bob Hose, Deputy Fire Chief-Administration, Westminster Fire Department
3. Amanda Martinez, GIS Specialist, City of Westminster
4. Jeff Brislawn, HMEM Program Manager, WSP
5. Bryan McCoy, City Forester, City of Westminster
6. Greg Moser, Emergency Manager, City of Westminster
7. Mikeal Parlow, Policy and Budget Coordinator, City of Westminster
8. Kit Redmer, Community Outreach Liaison, City of Westminster
9. Bridger Tomlin, Sustainability Associate, City of Westminster
10. Shelby Wood, Senior Business Resource Management Analyst, City of Westminster
11. Bruce Rindahl, Flood Warning Manager, Mile High Flood District
12. Christopher Johnson, Hazard Mitigation Planner, WSP
13. Natalie Schoen, Hazard Mitigation Planner, WSP
14. Mack Chambers, GIS Analyst, WSP

Introductory Remarks/Review of the planning process

Following introductions, Jeff Brislawn reviewed the planning process being followed and discussed the project status and progress made thus far. Highlights include:

- Kickoff meeting October 7, 2022
- Risk assessment update in progress
- Plan Update Guide sent out to participating jurisdictions – thanks to those that returned the guides so far.

- Public engagement activities in progress – two workshops held so far. A Firewise session in September and a flood awareness session on February 11th. Upcoming session in April for drought. Greg Moser, Emergency Manager with the City of Westminster, has been organizing these sessions and advertising through the Emergency Management Facebook page.

Update on Public Involvement Activities

Jeff Brislawn shared information on the public involvement activities thus far in the plan. This includes an online public survey which closed on January 31st and received 122 responses. The survey asked residents about their perceived level of significance for various hazards, the frequency with which hazards have disrupted their lives, and any suggestions for potential mitigation actions. The results revealed a large emphasis on drought related hazards and mitigation efforts. Other higher priority hazards included wind-drive/open space fire, hail, and winter storms. Planning and zoning regulations to avoid future losses was a popular mitigation action, along with drought and fire mitigation actions. See PowerPoint for a detailed summary of the public survey.

Hazards and Vulnerability Assessment Update

The general risk assessment requirements were outlined before turning to a detailed discussion of each hazard. Highlights were presented on each hazard included in the updated risk assessment chapter of the plan. Refer to the PowerPoint presentation for specific details on each hazard. Highlights of the discussion are noted by hazard in the table below.

Hazard or Topic	Meeting Discussion Notes
Climate Change	<ul style="list-style-type: none"> • Climate change is both a hazard and a process that affects and amplifies other natural hazards. • Natural hazards will include a section on impacts from climate change where relevant • No questions/comments from group
Flooding	<ul style="list-style-type: none"> • WSP summarized NFIP data and risk to property, people, and critical facilities • No questions/comments from group
Dam Incidents	<ul style="list-style-type: none"> • Greg Moser noted that the Emergency Action Plans for dams in the city are currently from 2017, but they are looking at getting those updated
Summer Storms	<ul style="list-style-type: none"> • WSP noted that lightning and hail is usually included in the summer storm hazard section, but each individual hazard will still be emphasized and past events will be summarized uniquely • Greg Moser and the rest of the HMPC agreed hail and lightning will be included in summer storms moving forward
Lightning	<ul style="list-style-type: none"> • Include in summer storm section • No questions/comments from group
Hail	<ul style="list-style-type: none"> • Include in summer storm section

Hazard or Topic	Meeting Discussion Notes
	<ul style="list-style-type: none"> No questions/comments from group
Tornado	<ul style="list-style-type: none"> No questions/comments from group
Severe Winter Storm	<ul style="list-style-type: none"> Greg Moser noted that ice storms have caused significant damages to local trees, in addition to hail and drought. Bryan McCoy, the City Forester, noted that the Urban Forest Management Plan is underway and will address these issues. The Plan will be active within the next couple weeks and could be tied into the Hazard Mitigation Plan Update. Greg also mentioned bomb cyclones (winter hurricanes) have been documented in the area and could be included.
Windstorm	<ul style="list-style-type: none"> Greg Moser asked how windstorms will be tied to wildfire/open space fire. Jeff explained that hazards with cascading impacts/related hazards will be noted in each hazard section. Bob Hose noted that a structure fire during a high wind day can lead to conflagrations that have no wildland fire component.
Extreme Cold	<ul style="list-style-type: none"> The group said to acknowledge social equity and unhoused populations in the vulnerability to this hazard Greg noted that one way the city has responded to extreme cold is to open warming shelters for the homeless. The city opened shelters for 4 days during the December 2022 event to help 65 people. The City is examining options to increase sheltering capabilities in the future.
Extreme Heat	<ul style="list-style-type: none"> Greg mentioned that there are many parks in the area that help with urban heat islands, and Parks and Recreation Facilities that can be used as cooling centers. Mack Chambers, GIS Analyst with WSP, noted that the City of Westminster had a tree sale event recently that helped the community access plants and help grow green spaces. Bryan noted that they sold 130 drought tolerant, diverse trees in about 10 hours. Bryan also noted there is a local study for tree equity conducted by University of Colorado grad students. Will send that to Jeff.
Drought and Water Scarcity	<ul style="list-style-type: none"> Greg noted that it's important to note the difference between long-term drought conditions and temporary ones. The city has been experiencing impacts from long-term drought. Regional long term aridification was noted as a potential concern.

Hazard or Topic	Meeting Discussion Notes
Open Space/Wind Driven Fire	<ul style="list-style-type: none"> • Greg noted that it's also important to note the difference between open space fires and wind driven fires. • Greg mentioned that the NW corner of the city is experiencing substantial development, which will change fire behavior. • Mack Chambers said the State Forest Service data used is based on 2017 data, but they'll be updating in the future to reflect new development.
Earthquake	<ul style="list-style-type: none"> • Greg noted that he was surprised by the lack of damage to water systems in the Hazus earthquake analysis because they have frequent water main breaks in the city. • Kit Redmer explained that the Washington DC earthquake was unexpected and significant damages occurred, could be the same here. • Jeff mentioned the possibility of earthquakes due to fracking
Swelling Soil	<ul style="list-style-type: none"> • Greg noted that swelling soils are a public education opportunity. Responsible landscaping can prevent accumulation of water near homes. • Cycles of drought and precipitation can lead to greater likelihood of damages from swelling soil. • Jeff mentioned that he received a "Guide to Swelling Soils" when purchasing his home in Colorado.
Erosion, Deposition, and Turbidity	<ul style="list-style-type: none"> • Andrew Hawthorn noted that he felt as though erosion, deposition, and turbidity issues are more specific to water supply and water quality issues
Invasive and Noxious Species	<ul style="list-style-type: none"> • Bryan noted that an update to the landscape code is upcoming which will address Emerald Ash Borer. • Greg noted that there has recently been the first confirmed cases of zebra mussels in Colorado on the west slope • Standley Lake tried to regulate spread of invasive species by spraying down water crafts before and after entering the lake and limiting boating access. • Another opportunity for public education
Epidemic/Pandemic	<ul style="list-style-type: none"> • Greg noted that the Plan should include impacts from the West Nile Virus or impacts to bird populations from Avian Flu.
Solar/Geomagnetic Storm	<ul style="list-style-type: none"> • Jeff mentioned that a possible mitigation action for this hazard is backup generators

A ranking summary of hazards from the previous plan is provided in the image below. The planning committee was asked what adjustments to natural hazard rankings they suggest based on the image. One member and Greg suggested adding wind driven fire to D4 (separate from

open space fire). Another suggested moving earthquake to A4, because although it is highly unlikely, the city is not prepared in terms of infrastructure and planning, so the consequences are higher. Tornadoes should also be moved to C3 or C4 because tornadoes in the area have been rare.

Jeff asked why climate change and drought are ranked so high. Greg responded that the probability of both hazards are high and they exacerbate all other weather related hazards, so they should remain at a high ranking.

		Natural Hazard Relative Risk Rating					
		1	2	3	4	5	
		Consequences					
		Lowest				Highest	
Likelihood	Most	E	<ul style="list-style-type: none"> • Windstorm 	<ul style="list-style-type: none"> • Lightning • Hail • Swelling Soils 	<ul style="list-style-type: none"> • Severe Winter Storms 	<ul style="list-style-type: none"> • Invasive & Noxious Species • Severe Summer Storms 	<ul style="list-style-type: none"> • Climate Change • Drought
	D		<ul style="list-style-type: none"> • Open Space Fire 	<ul style="list-style-type: none"> • Extreme Cold • Extreme Heat 	<ul style="list-style-type: none"> • Flooding • Erosion, Deposition and Turbidity 		
	C						
	B				<ul style="list-style-type: none"> • Tornado 	<ul style="list-style-type: none"> • Pandemic 	
	Least	A			<ul style="list-style-type: none"> • Earthquake 		<ul style="list-style-type: none"> • Dam Failure • Geomagnetic Storm

Capability Assessment Update

Jeff reviewed a discussion on the update to the capability assessment, which includes the regulatory, staff, and technical resources currently available. The information provided by City departments in the Plan Update Guide will be used to inform the capability assessment in the Plan. Jeff also noted several city plans that will be used to supplement the Hazard Mitigation Plan, including the Drought Management Plan (2019), Local Emergency Operations Plans, Sustainability Plan, and Transportation Plans.

Some of the capability improvements in recent years noted by the group included:

- Firewise promotion
- Alert and warning capability improvements including IPAWS (Integrated Public Alert & Warning System) wireless emergency alerts

Jeff then asked the group what opportunities for enhancement of mitigation capabilities they foresee. The planning committee noted an emerald ash borer awareness campaign starting this spring and that the city will be replacing storm pipes in critical areas to pass larger storm events.



Jeff asked if the City was StormReady certified. Greg said not but this might be something to look into as a capability enhancement.

Goals Review and Mitigation Strategy Update Needs

Jeff led a brief discussion on current goals and objectives. He asked the group what adjustments should be made to the current list. One member noted that there should be more emphasis on water-wise landscaping and programs for drought mitigation. Jeff also noted that it would be beneficial to reference/integrate FEMA lifelines in the goals and objectives; an objective related to dams might be considered given the risk from dam inundation, and to align with newer FEMA grant programs such as the High Hazard Potential Dam Grant.

Next Steps/Adjourn

The project schedule was reviewed:

Tasks	Dates
B.1 Hazard Mitigation Plan Update	
Task 1: Organize Resources	Kickoff held Oct 2023
Task 2: Hazard Identification and Risk Assessment	Oct-Feb 2023
Task 3: Develop a Mitigation Strategy	March-April 2023
Task 4: Plan Adoption, Monitoring, & Evaluation	March – July 2023; DHSEM submittal late April; FEMA approval anticipated June; Local Adoption assumed in July
Task 5 Grant Management and Lifecycle Cost Analysis	March-July 2023 as needed; lifecycle analysis March 2023
B.2 Flood Emergency Operations Plan and FEMA Related Community Rating System Analysis	
Task 1: Review, Revise and Develop Flood Threat Analysis and Mapping	Jan-Feb 2023
Task 2: Develop Early Flood Threat Warning Criteria	March 2023
Task 3: Develop Flood Response Plan Responsibilities for the Floodplain Administrator	March-April 2023
Task 4: Quantify FEMA CRS Points for Flood Warning and Response Actions and Recommend Future Actions	March-April 2023

Adjourn

The meeting adjourned at 11:30 am

Points of Contact for this HMP update effort:



Jeff Brislawn
WSP Project Manager
Jeff.brislawn@wsp.com
(303) 704-5506

Greg Moser
Emergency Management Coordinator
gmoser@CityofWestminster.us
(303) 658-4550



City of Westminster 2023 Hazard Mitigation Plan Update Risk Assessment Meeting Chat Log

[2/22 9:36 AM] Martinez, Amanda

Amanda Martinez, GIS Specialist, City of Westminster

[2/22 9:36 AM] Schoen, Natalie

Natalie Schoen, Hazard Mitigation Planner, WSP

[2/22 9:36 AM] Wood, Shelby

Shelby Wood, Senior Business Resource Management Analyst, City of Westminster

[2/22 9:36 AM] Bruce Rindahl

Bruce Rindahl, Flood Warning Manager, MHFD

[2/22 9:36 AM] Parlow, Mikeal

Mikeal Parlow, Policy and Budget Coordinator, Westminster

[2/22 9:36 AM] Redmer, Kit

Kit Redmer, Community Outreach Liaison at Westminster

[2/22 9:36 AM] Tomlin, Bridger

Bridger Tomlin, Sustainability Associate, City of Westminster

[2/22 9:37 AM] McCoy, Bryan

Bryan McCoy, City Forester, City of Westminster

[2/22 9:37 AM] Hose, Bob

Bob Hose, Deputy Fire Chief-Administration, Westminster Fire Department

[2/22 9:39 AM] Hawthorn, Andrew

Andrew Hawthorn, Stormwater Utility Manager, Westminster

[2/22 9:46 AM] Johnson, Christopher A

Christopher Johnson, Hazard Mitigation Planner, WSP

[2/22 9:59 AM] Moser, Greg

Greg Moser, Westminster Emergency Management Coordinator

[2/22 10:00 AM] Hawthorn, Andrew

Greg, you may need to check that this is still recording. I need to jump off for another meeting.

[2/22 10:12 AM] Tomlin, Bridger

have to jump to another meeting, but back in a jiffy!

[2/22 10:29 AM] McCoy, Bryan

sorry, i missed that last comment - had to deal with a snow related issue



[2/22 10:29 AM] Chambers, Mack

The City had a Tree sale event recently. I think the trees sold out really quick though.

[2/22 10:30 AM] McCoy, Bryan

Yes, we sold 130 drought tolerant, diverse trees in about 10 hours
like 1

[2/22 10:54 AM] Redmer, Kit

All — I have to jump off but thank you the presentation!

[2/22 11:31 AM] Martinez, Amanda

I need to hop off, thank you!

[2/22 11:34 AM] Nims, Josh

Drought Plan is on City website

[2/22 11:34 AM] Nims, Josh

Sorry, I'm on another call

[2/22 11:36 AM] Brislawn, Jeff P

Jeff Brislawn, Project Manager WSP

[2/22 11:37 AM] Chambers, Mack

Mack Chambers, GIS Analyst WSP

City of Westminster Hazard Mitigation Plan Update Mitigation Strategy Meeting Agenda

Date: Thursday, May 10th, 2023
10:00 am-12:00 pm MST

Meeting at: Westminster City Hall
4800 W. 92nd Ave.
Westminster, CO 80031

Project: City of Westminster Hazard Mitigation Plan Update

Subject/Purpose

The purpose of this meeting is to review the planning process so far, then modify, add, and/or delete mitigation actions and projects applicable to City of Westminster based on HMPC input and pertinent plan goals. Prioritization of mitigation projects will be conducted as well, and next steps to plan finalization, including future plan implementation and maintenance, will be discussed.

Attendees: City of Westminster Hazard Mitigation Planning Committee and Stakeholders

1. Introductions
2. Review of the Planning Process
3. Review of possible mitigation activities and alternatives
4. Discuss criteria for mitigation action selection and prioritization
5. Review of progress on existing actions in the plan
6. Brainstorming Session: Development of new mitigation actions (group process)
7. Prioritize mitigation actions (group process)
8. Discuss plan implementation and maintenance
9. Discuss next steps
10. Questions and Answers/Adjourn

**City of Westminster, Colorado
Hazard Mitigation Plan 2022-2023 Update & Flood Emergency
Operation Plan**

**Mitigation Strategy Meeting Summary
Thursday, May 10, 2023
10:00 am – 12:00 pm MST
Microsoft Teams Meeting**

Introductions

This document summarizes the kickoff meeting for the City of Westminster Hazard Mitigation Plan (HMP) update in 2022 and flood Emergency Operation Plan (EOP). The meeting was facilitated by Jeff Brislawn with WSP (formally known as Wood Environment & Infrastructure Solutions, Inc.) via Microsoft Teams, with members of the Hazard Mitigation Planning Committee (HMPC) in attendance. WSP serves as the consulting firm working under a contract with the City of Westminster to facilitate the planning process and develop the updated HMP for the city.

Jeff welcomed all meeting participants to the meeting. The primary focus of the meeting is the mitigation strategy meeting, meant to reflect the updates necessary within the planning process:

- Updates on mitigation activities and strategies learned from previous meetings
- How to include public participation within the HMP
- Opportunity to identify new mitigation actions

Jeff touched on the mitigation planning process. Nothing that the HMP is halfway through the 9 tasks that have been set. The plan is in the process of being fully compiled, and this meeting is building off the kickoff meeting had in October in 2022, February and the public surveys that were conducted which included good feedback. The goals have been relayed and also Greg Moser has done a great job of including needs. Wildfire, Flood and Drought are the three key strategic needs. The drought meeting had the largest turnout, Greg Moser notes. He notes that a lot of people engaged within this meeting and cyber and community hazard materials. Nuclear attack will be the next upcoming meeting later this year.

Parallel to this effort is the Flood Emergency Operations Plan (EOP), Jeff notes. This will help the City of Westminster get a better CRS Score rating and help with the flood communication response procedures that the city currently has and how to update them. Jeff

SIGN-IN SHEET
CITY OF WESTMINSTER COUNTY
MULTI-HAZARD MITIGATION PLAN UPDATE
Meeting # 3 - Mitigation Strategy
Thursday May 10th, 2023; 10:0 am - 12:00pm
4800 W 92nd Ave, Westminster, CO 80031

Name	Organization and Department	Title	Phone	E-mail
Paul Schmieder	Sustainability office - ED	Chief Sust. Officer	658-2014	pschmie@cityofwestm...
Bridger Tomlin	Sustainability - ED	Sustainability Assn	658-2662	btomlin@cityofwestm...
Greg Moser	Emergency Mng Emergency Mng Coordinator	FMP	303 589-7812	gmoser@cityofwestm...
Andrea Song	PWU - Utilities operation	Manager	658-2507	asong@cityofwestm...
Mikael Parlow	Policy + Budget	Policy + Bud Coord.	718 614 5705	mparlow@cityofwestm...
Cam Nelson	WSP, Consultant	Consultant	303-596-9977	cameron.nelson@wsp.co
Andrew Hawthorn	PW Pen Dev	Storm Water Utiliz		
Brook Hufferd	PW PWU	Streets Supervisor		
Heather Osterstiller	PW PD	Flood plain Mng		
Josh Nims	PWU- WRD	Intern Wea Mng	x2180	jnims@cityofwestm...

Public Survey Results

Jeff noted the public survey results gained from the public participation. 122 responses. Drought, wind drive and Wildfire ranked the highest followed by windstorms. The last meeting went over hazard specific risks to the city and how they compare to the public survey results and hazard rankings from the 2018 HMP. Jeff notes that wind driven wildfire has changed to a higher risk level. Flooding also has become more of a higher risk. Erosion Jeff notes has been lower and is classified more as of a water viability issue.

Meeting participants notes air quality impacts, and how first-responders are having to respond to respond to people with asthma and other respiratory related issues. Greg notes that air quality impacts should be addressed under climate changes. Data provided to supplement this can be provided, and can be mentioned in the climate change and vulnerability sections. They would like this captured in the HIRA and HMP sections. City is currently doing activities to address these issues, and Jeff notes that this will be noted within the plan. Greg notes that the city is located downstream from a lot of pollutants, and are striving to be in compliance with ozone regulations. Jeff notes particular differences between mitigation categories most notably that FEMA does not count emergency services as an applicable CRS Category on which to be scored.

Jeff also covered the “Four A’s” and how to utilize alternatives. Jeff notes the open space mitigation actions that the city has done as an example of utilizing these alternatives. Open space falls under the avoidance category. FEMA Community Lifelines were also discussed and how they relate to critical facilities and different examples of how to upgrade existing infrastructure to better meeting evolving hazards and accommodate FEMA compliance.

Climate Change Considerations were also discussed by Jeff and how it affects the city/community. Adaptive capacity was discussed and what we can do to accommodate changing hazard risks. Prioritizing needs and how to strategize to meet the needs caused by climate change. Also how to reduce the impacts of long-term hazards and risk.

The HMP plan will keep the city eligible for FEMA grant funding. Jeff notes how more funding has become available through programs like BRIC and the FMAG’s. Jeff notes that you can get funding from FMAG for buildings, fuel removal. Flood mitigation was also discussed and how it relates to different activities available. Which activities are more relevant to Colorado and which ones aren’t in relation to grant funding.

Meeting participants noted when asked about grant funding that electrical and public work utilities and how the shelters currently do not have generators and also don’t have generator hookups for public shelters. Greg and other meeting participants notes that there is no generator hookups currently for shelters in the cities, including the public safety center which does not have backup power. Extreme weather can affect things like boilers, etc. Greg notes that they have 24 hours worth of fuel on hand but making shelters and the public safety shelter more resilient. Jeff notes that their has been adjustments made to accommodate these things such as solar power, etc.

Review of the Progress made on Mitigation Actions

Jeff notes the hazard risk section, rankings and prioritization. Things like public amenities such as retention ponds that also serve as a drainage preventive measure. He also notes that FEMA or other federal funding will result in a more detailed BCA and also no adverse impacts to the environment.

Progress on previous Mitigation Actions

Greg notes that extreme heat has become more prevalent. He also notes that updating park amenities will help accommodate these events such as updates to bathrooms and also adding canopies to parks to help people seek shelter in the wake of these hazardous events. This also relates to social equity to people who might not have residential amenities which would help escape extreme weather events. Notes how we can provide updates to the power grid to assist people who may sustain power outages during peak usage hours which can cause rolling power outages. Solar power is a useful insight to help combat power outages.

Greg notes mitigation activities in Arizona where canopies also double as solar panels and how to that could be utilized in the city. Also recently hail which has been the most cost impactful hazards within the city recently and also historically. Also how drainage concerns could impact asphalt parking lot/canopy in that the canopies could affect or increase surface runoff. Jeff notes that rain barrels are now allowed in Colorado and how this could be a potential solution. Heather notes that a surface water runoff can be positively impacted by rain barrels. She also noted that a company in Fort Collins is utilizing these to help prevent the

drainage system from being overwhelmed. This is a mitigation action that would reduce costs and also damage. This hm action is being considered for mitigation actions.

Greg notes that Emerald , removal of at risk trees with the replacement of more sustainable forest canopies and also the removal of lawns and the replacement of more useful environmentally friendly plants. Greg also notes that this should be reviewed and also how to reduce impacts via this method. The question asked is would this be fundable by FEMA, Jeff notes that he is currently unsure of if this is a fundable project but seems like a great project proposal. Greg notes 60,000 in trees and \$10 million in damages. Greg and also meeting participants notes this is a good proposal and should be noted within the plan to help with documentation for potential funding. This also applies to water conservation needs.

Mitigation Action Tracker Update

Jeff notes to update this as much as possible. Whether completed in process or a “not started” project. Any proposals or on-going projects can be noted in the mitigation capabilities section. Also explaining the process and how they are organized based on hazard rankings.

Greg notes that winter storms has become more of an important hazardous focus due to a rise in the homeless population. Greg notes that politically not much can be done by the city but it is a major concern to the city. Along with drought and water conservation concerns. Jeff notes that this is a complex issue due to the unhoused and will require a collaborative measure needed by the different stakeholders. Greg notes that it is a unpopular topic of discussion and Jeff notes that at the recent ASFPM Conference this was a topic on how to help the homeless and underserved populations. It is a public health concern as it affects infrastructure and a variety of other environmental concerns. Heather also notes that there are people living in stormwater pipes and inlets. As it provides shelter when not raining but is dangerous when a rain event occurs. It also affects debris in waterways also, Jeff notes.

- Would the City rather focus on existing actions or new actions?
 - Greg notes that new actions should be the focal point but notes the difficulty of getting funding and how the state and FEMA has extremely stringent requirements.
 - Greg asks does the City and meeting participants have any important project proposals/mitigation actions that are relevant.
 - Jeff notes that several proposals within the meeting will be new mitigation actions within the plan.
 - Jeff notes that mitigation actions will need to have at least new one and also the new requirement from FEMA that this new action cover all relevant hazards

Suggestions for New HM Actions

Public involvement has great engagement digitally but Greg notes that public engagement in-person has become a larger challenge.

- New mitigation actions seemingly can be centered around solar power projects and will coincide with upcoming project proposals for the city.
- Hazardous Waste materials disposal programs is also a action focal point related to where to get rid of hazardous waste materials such as batteries. The county has programs but nothing currently city wide.
 - Things such as composting sites and barrels should be a potential hazmat material project. What is it mitigating in relation to hazards? Jeff notes that it has to be tied back to hazards. Greg notes that it reduces the carbon footprint, also solar power assists with this also.
 - Kitchen waste emits methane at landfills but doesn't if composted. Garden and kitchen waste can also be distinguished into different streams. Jeff notes that this can also help with water conservation which can be a mitigation benefit
 - This is an example of new technology and a new alternative of thinking outside the box
- Heather notes that as cities become more urbanized that space is running out for landfills, which is a sustainability issue. Yet with composting projects this can help affect this in a positive way.

Greg notes that Firewise is being promoted. Debris located on peoples property is a main concern of wildfire causes and how new mitigation actions can be utilized to update these. Also what trees to plant that will be the canopy in 30 years. What to plant, which plants require less water and are more durable to fire. Wildfire Urbanization Plan will be able to help with these issues, climate proposals etc.

Incorporation into Other Planning Mechanisms

The cities Sustainability Plan covers different challenges and solutions to current environmental issues affecting the city. Greg notes that resources related to public infrastructure is directly affected by the at-risk homeless populations and their resulting drug usage etc. Being able to communicate how to qualify for BRIC project funding is a important component in incorporating into existing plans and projects. Jeff recommends keeping plans/projects more focused and achievable. Greg notes that communicating the grant process is a main priority. A proposal of identifying plans that are underway and how to use BRIC to supplement them will help with sustainability.

Identifying gaps on what needs to be included. Heather notes that Mondays are better for scheduling a Mitigation Action and Flood EOP Meeting.

City of Westminster Emergency Operations Plan (EOP)

Greg notes that current Flood EOP is in good shape on standard operating procedures in relation to flooding within the city. Main concerns and opportunities for more information is in regard to what requirements does FEMA desire and require to raise CRS Scores. Identifying gaps on what needs to be included. Heather notes that Mondays are better for scheduling a Mitigation Action and Flood EOP Meeting.

Jeff also asked if it was any flooding from the recent 2 day rain event around Westminster and the Denver Metro area. Heather noted that the some lower-lying inlets and the local Cost Co. sees some flooding. Which normally occurs during more sustained raining events. She also notes that a local storage unit has seen flooding due to debris clogging drainage areas. She also noted that she'll check, as it has been a recurrent hazard in previous years. It also makes the roadway for the storage unit owner impassible

Conclusion

The Mitigation Action Worksheet will be sent out and also the Microsoft Meeting Teams Chat Log was saved.

Name	Jurisdiction	Title	Meeting 1	Meeting 2	Meeting 3
Bob Krugmire	City of Westminster	Water Resources Engineer	Y		
Mikeal Parlow	City of Westminster	Policy and Budget Coordinator	Y	Y	Y
Bruce Rindahl	MHFD	Flood Warning Manager	Y	Y	
Seth Plas	City of Westminster	Capital Projects Administrator	Y		
Shelby Wood	City of Westminster	Senior Business Resource Management Analyst	Y	Y	
Amanda Martinez	City of Westminster	GIS Specialist	Y	Y	
Bridger Tomlin	City of Westminster	Sustainability Associate	Y	Y	Y
Andrew Hawthorn	City of Westminster	Stormwater Utility Administrator	Y	Y	Y
Brock H	City of Westminster	Streets Supervisor			Y
Heather Otterstetter	City of Westminster	Stormwater Coordinator	Y		Y
Paul Schmiechen	City of Westminster	Chief Sustainability Officer	Y		Y
Kit Redmer	City of Westminster	Community Outreach Liaison	Y	Y	
Greg Moser	City of Westminster	Emergency Management Coordinator	Y		Y
Andrea Song	City of Westminster	Utilities Operations Division Manager	Y		Y
Josh Nims	City of Westminster	Interim Water Resources and Quality Division	Y		Y
Irene Merrifield	CODHSEM	Mitigation Planner	Y		
Brian McCoy	City of Westminster	City Forester		Y	
Bob Hose	Westminster Fire Department	Deputy Chief	Y	Y	
Kurt Muehlemeyer			Y		
Christopher Johnson	WSP	Hazard Mitigation Planner	Y	Y	
Natalie Schoen	WSP	Hazard Mitigation Planner	Y	Y	
Mack Chambers	WSP	GIS Analyst	Y	Y	
Jeff Brislawn	WSP	Project Manager	Y	Y	
Cameron Nelson	WSP	Hazard Mitigation Planner			Y

From: [Bauer - DNR, Kallie](#)
To: [Chambers, Mack](#); [Brislawn, Jeff P](#); [Field, Scott](#); [Carr, Amy](#)
Cc: [John Hunyadi - DNR](#); [Mark Thompson - CDPS](#)
Subject: Re: Dam Safety GIS data to support various hazard mitigation planning efforts.
Date: Thursday, May 12, 2022 11:00:39 AM
Attachments: [image001.png](#)

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Mack,
Please see our responses below in blue. In general, we have this data collected in google folders and has been kept relatively up to date, Please recall this shapefile information is collected from Owners development of inundation maps and is not necessarily updated on a routine schedule.

Thanks,
Kallie

On Wed, May 11, 2022 at 5:18 PM Chambers, Mack <mack.chambers@woodplc.com> wrote:

Hi Kallie,

Wood is under contract with several Colorado local government entities supporting the update of local hazard mitigation plans. Currently we are working the following plans and we are reaching out to ensure we have the latest data that may be available from the DWR:

- City of Manitou Springs
- Archuleta County
- Pitkin County
- San Luis Valley Region (Alamosa, Conejos, Costilla, Mineral, Rio Grande and Saguache)

Data we are looking for include:

- GIS data with point locations of Dams with attributes including hazard level and condition rating
 - we have access to 2022 NID but will use DWR if more current
 - can download spreadsheet and convert to shapefile if needed

You should be able to download the information from the Colorado Information Market place which is updated more frequently than the NID.

-
- Low head dams
 - can download spreadsheet and convert to shapefile if needed, latest update is 2020.

This data is located on the DNR website <https://dnr.colorado.gov/initiatives/colorado-low-head-dams>
To be clear these are viewed as a recreational user risk not a public safety downstream of the low head dam. We do not regulate these.

-
- Latest version of database of dams with ratings for non-failure release flood potential

The google file you have access to should be the most up to date. We have not done another version lately. You should receive an invite from John Hunyadi granting you access.

-
- Inundation Limits

There is a google drive that has all of the inundation maps for the state. John has shared this folder with you. As you stated these are for official use only and not to be shared with the public or published as part of the hazard mitigation plan.

-

We have been using the DWR Inundation layer since 2019 and have the 2021 version. We are also understand that the inundation data is for official use only; we do not intend to publish any maps representing their extents but expect to use them for analysis of downstream risk.

We are looking to have the data by the end of May.

Thank you!

Mack Chambers

GIS Analyst

Mobile: (720) 839-1516

www.woodplc.com

wood.

--

Kallie Bauer, P.E.
Dam Safety Engineer



P 970.352.8712 | C 970.420.4539
1809 56th Avenue, Greeley, CO 80634

kallie.bauer@state.co.us | www.colorado.gov/water

From: [Brislawn, Jeff P](#)
To: [Field, Scott](#); [Johnson, Christopher A](#)
Subject: FW: Coordination with CO Climate Center on various Local Hazard Mitigation Plan updates
Date: Wednesday, November 2, 2022 10:13:39 AM
Attachments: [image001.png](#)
[image002.png](#)

Here is response from CCC for planning process documentation and suggested resources.



Jeff Brislawn, CFM

Sr Associate, Hazard Mitigation and Emergency Management

M+ 1 303-704-5506

From: Schumacher, Russ <Russ.Schumacher@colostate.edu>
Sent: Wednesday, October 19, 2022 8:11 PM
To: Brislawn, Jeff P <jeff.brislawn@wsp.com>
Subject: Re: Coordination with CO Climate Center on various Local Hazard Mitigation Plan updates

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Hi Jeff,

Thanks for getting in touch about this.

Probably the one thing worth being aware of is that we're in the process of updating the "Climate Change in Colorado" report that was last published in 2014 (http://wwa.colorado.edu/sites/default/files/2021-07/Climate_Change_CO_Report_2014_FINAL.pdf). We've finished some of the preliminary work (mainly updating some of the figures from the 2014 report to include observations from more recent years), and will soon be starting some updates to the future projections, etc. The plan is to finish and publish it by next spring/summer.

Other than that though, we haven't really been involved in new work that's at the level of what would be worth incorporating into these plans. There has been a lot of recent research related to drought and wildfire given what's happened in the west in the last couple decades – it's generally not specific to Colorado, but still relevant. For example, the NOAA report on the 2020 drought: <https://www.drought.gov/documents/noaa-drought-task-force-report-2020-2021-southwestern-us-drought> and various wildfire studies like <https://www.pnas.org/doi/full/10.1073/pnas.1607171113> and <https://www.pnas.org/doi/pdf/10.1073/pnas.2111875118>

I've also been contacted by a couple of county officials about their plan updates (though not any of the counties you mentioned).

Anyway, hope that helps a bit – let me know if there's additional info I can help with!

Russ

—

Russ S. Schumacher
Director, Colorado Climate Center
Colorado State Climatologist
Professor, Department of Atmospheric Science
Colorado State University
e-mail: russ.schumacher@colostate.edu
phone: 970.491.8084
web: <https://www.atmos.colostate.edu/people/faculty/schumacher/>

From: "Brislawn, Jeff P" <jeff.brislawn@wsp.com>
Date: Wednesday, October 19, 2022 at 11:08 AM
To: "Schumacher,Russ" <Russ.Schumacher@colostate.edu>
Cc: "Field, Scott" <scott.field@wsp.com>, "Johnson, Christopher A" <christopher.johnson@wsp.com>
Subject: Coordination with CO Climate Center on various Local Hazard Mitigation Plan updates

**** Caution: EXTERNAL Sender ****

Hi Russ,

Hope you are doing well. I wanted to let you know that Wood has sold its Environment & Infrastructure business, which includes our Hazard Mitigation and Emergency Management program, to WSP recently. Our emails now have WSP.com on them, but other than that its business as usual and we are excited to be part of a global firm with a core focus on resiliency and sustainability.

Also, I wanted to make you aware that we are under contract with several CO local governments to update their local hazard mitigation plans. I am reaching out on behalf of our clients to see if there are any initiatives or studies related to these entities that the Colorado Climate Center may be engaged in that we should be aware of. We have been incorporating climate change into the hazard risk assessment as to how it may influence severity and frequency of relevant hazards, based on Colorado studies (Colorado Climate Change Vulnerability Study, CO State HMP, CO Drought Plan etc.) and the 4th National Climate Assessment.

Many of the planning efforts are in final stages and we will be making the drafts available for review

and comment also when we get to that point. Below is the list of current clients and planning efforts.

City of Manitou Springs

City of Westminster (initial stages)

San Luis Valley Region: Alamosa County, Conejos County, Costilla County, Mineral County, Rio Grande County and Saguache County

Archuleta County

Pitkin County

Delta County (initial stages)

Regards,

Jeff



Jeff Brislawn, CFM

Sr Associate, Hazard Mitigation and Emergency Management

M+ 1 303-704-5506

WSP USA
2000 S. Colorado Blvd., Ste. 2-1000
Denver, CO 80222

wsp.com

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-LAEmHhHzdJzBITWfa4Hgs7pbKl

From: [Kelsey Lanham](#)
To: [Brislawn, Jeff P](#); [Johnson, Christopher A](#)
Cc: [Keith Buckmiller](#); [Hannah Van Nimwegen](#)
Subject: FW: Manitou Springs Hazard Mitigation Plan DRAFT
Date: Tuesday, December 13, 2022 1:45:12 PM
Attachments: [image001.png](#)

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Kelsey Lanham (she/hers)

Planning Technician
City of Manitou Springs

Office | (719) 685-4398

Direct | (719) 685-2553

Cell | (719) 313-8590

klanham@manitouspringsco.gov

**606 Manitou Avenue
Manitou Springs, CO 80829**

www.manitouspringsgov.com

From: Bauer - CDOT, Bradley <bradley.bauer@state.co.us>
Sent: Tuesday, December 13, 2022 1:26 PM
To: Kelsey Lanham <klanham@manitouspringsco.gov>
Cc: R2 Yun Su Han - CDOT <yunsu.han@state.co.us>
Subject: Re: Manitou Springs Hazard Mitigation Plan DRAFT

Kelsey,

In response to CDOT pages 13/51: We'd be glad to partner with mitigation efforts that either affect US 24 or from US 24. Consideration will have to be determined in regards to severity, mitigation needs, and costs. I am sure you are aware that CDOT has been there to assist with past mitigation efforts and we look forward to working with you on future projects as funding and time allows.

Thanks
Brad

Bradley K. Bauer
Deputy Maintenance Superintendent
Region 2



P 719.546.5419 | C 719.659.8205
bradley.bauer@state.co.us | www.codot.gov | www.cotrip.org
5615 Wills Blvd, Pueblo, CO 81008

On Mon, Dec 12, 2022 at 4:11 PM Kelsey Lanham <klanham@manitouspringsco.gov> wrote:

Hi Everyone,

Happy Monday! Attached to this email is the first complete draft of the updated Hazard Mitigation Plan for Manitou Springs. The draft is ready for internal review before it is finalized for public review and subsequent state and FEMA review and approval. **We are asking for review and comments by December 30th**. Please note anything in **yellow highlight**, are areas that need verification or clarification. **Green highlights** will be addressed by the consultant in a subsequent draft. Please focus on Chapter 4 in particular to ensure that the mitigation action strategy is accurate; there is still an opportunity to adjust or refine the actions or add new actions if desired. Comments are preferred in Track Changes in Word or can be summarized in an email. If you're tracking changes, make sure the track change feature is enabled (review tab > track changes), please save and send the document with the changes.

Please return feedback to myself (klanham@manitouspringsco.gov) and/or Chris Johnson (christopher.johnson@wsp.com).

Thanks so much for helping make this plan reflect our unique community! If you have any questions, please let me know.

Kind Regards,



Kelsey Lanham (she/hers)

Planning Technician
City of Manitou Springs

Office | (719) 685-4398

Direct | (719) 685-2553

Cell | (719) 313-8590

klanham@manitouspringsco.gov

**606 Manitou Avenue
Manitou Springs, CO 80829**

www.manitouspringsgov.com

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From: [Miller - DOLA, Anne](#)
To: [Brislawn, Jeff P](#)
Cc: [Field, Scott](#); [Johnson, Christopher A](#)
Subject: Re: Coordination with CRO on various Local Hazard Mitigation Plan updates
Date: Wednesday, October 19, 2022 2:07:16 PM
Attachments: [image001.png](#)

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Hi Jeff,
Thanks for the update.

CRO is working with 16 rural regions on resiliency and recovery roadmaps, with a focus on economic resiliency. You can learn more [here](#). We're over a year into the 2-year initiative with roadmaps under development now.

Best regards,
Anne

On Wed, Oct 19, 2022 at 10:55 AM Brislawn, Jeff P <jeff.brislawn@wsp.com> wrote:

Hi Anne

Hope you are doing well. I wanted to let you know that Wood has sold its Environment & Infrastructure business, which includes our Hazard Mitigation and Emergency Management program, to WSP recently. Our emails now have WSP.com on them, but other than that its business as usual and we are excited to be part of a global firm with a core focus on resiliency and sustainability.

Also, I wanted to make you aware that we are under contract with the following local governments to update their local hazard mitigation plans. I am reaching out on behalf of our clients to see if there are any initiatives related to these entities that the Colorado Resiliency Office may be engaged in that we should be aware of. Many of the planning efforts are in final stages and we will be making the drafts available for review and comment also when we get to that point.

City of Manitou Springs

City of Westminster (initial stages)

San Luis Valley Region: Alamosa County, Conejos County, Costilla County, Mineral County, Rio Grande County and Saguache County

Archuleta County

Pitkin County

Delta County (initial stages)

Regards,

Jeff



Jeff Brislawn, CFM

Sr Associate, Hazard Mitigation and Emergency Management

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Denver, CO 80222

wsp.com

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-LAEmHhHzdJzBITWfa4Hgs7pbKI

--

Anne Miller

Colorado Resiliency Office, Director



C 303.915.6102
1313 Sherman St., Suite 521, Denver, Colorado 80203
www.coresiliency.com | www.colorado.gov/dola

[Sign up to receive the CRO newsletter.](#)

Under the Colorado Open Records Act (CORA), all messages sent by or to me on this state-owned e-mail account may be subject to public disclosure.

From: [Scot Fitzgerald](#)
To: [Chambers, Mack](#)
Cc: [Brislawn, Jeff P](#); [Field, Scott](#); [Carr, Amy](#); [Karen Berry](#); [Jonathan Lovekin](#)
Subject: Re: [External] Geologic Hazards GIS data to support various hazard mitigation planning efforts.
Date: Thursday, May 12, 2022 11:57:12 AM
Attachments: [image001.png](#)

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Mr Chambers

You can in fact add them for visualization in ArcCatalog and pull them into your ArcMap or ArcPro projects with steps 1-3 below. You can do limited analysis with just the feature service which meets most peoples needs.

If you need to further analysis in custom workflows and want the feature classes then you can do the workflow below and export your region of interest. We don't typically advertise this workflow, especially for this web map because it is a beta product, but Im guessing you can export what you need faster than I can package it up for you. If you do not feel like doing this you can send me your regions of Interest and I will export what you need.

1. Open ArcCatalog, choose "Add ArcGIS Server"
2. Choose "use GIS service" and then in the Server URL box put your full server location, ie CGS's REST directory: <https://cgsarcimage.mines.edu/arcgis/rest/services>
3. Open a project in ArcMap or Pro and then drag over your feature class from the REST service directory you just added in Catalog
4. Then search for the tool "Feature Class to Feature Class" in ArcMap or "WFS to Feature Class" in Pro
5. Export the Feature class to your working GDB for that project and then add to your map.

As for the question about recent or ongoing geologic studies I have CC'd Karen Berry and Jonathan Lovekin to reply to this. Feel free to reach out to them and they might be able to provide more information on those that what I am aware of.

Please let me know if you need further help!

thanks,

F Scot Fitzgerald, GISP
Colorado Geological Survey
Colorado School of Mines
GIS Analyst II
ffitzger@mines.edu

From: Chambers, Mack <mack.chambers@woodplc.com>
Sent: Thursday, May 12, 2022 11:42 AM
To: Scot Fitzgerald <ffitzger@mines.edu>
Cc: Brislawn, Jeff P <jeff.brislawn@woodplc.com>; Field, Scott <scott.field@woodplc.com>; Carr, Amy <amy.carr@woodplc.com>
Subject: RE: [External] Geologic Hazards GIS data to support various hazard mitigation planning efforts.

Hi Scot,

Thank you for the response and the link. From what I can tell I can only view these layers and can't export them for analysis or mapping outside of your server. Is it possible to obtain the shapefiles? If I'm missing something please let me know.

Are there any recent (past 4-5 years) or ongoing studies on geologic hazards that we should know about or describe in

Matt Morgan
Assistant Director/Senior Research Geologist
Colorado Geological Survey
College of Earth Resource Sciences & Engineering
Colorado School of Mines
1801 Moly Road
Golden, CO 80401
email: mmorgan@mines.edu
phone: o-303-384-2647 c-720-346-8606
website: <http://coloradogeologicalsurvey.org/staff/matt-morgan/>

From: Chambers, Mack <mack.chambers@woodplc.com>

Sent: Wednesday, May 11, 2022 9:34 AM

To: Matthew Morgan <mmorgan@mines.edu>

Subject: [External] Geologic Hazards GIS data to support various hazard mitigation planning efforts.

Hi Matt,

Wood is under contract with several Colorado local government entities supporting the update of local hazard mitigation plans. Currently we are working these plans and we are reaching out to ensure we have the latest geologic hazards data that may be available from the CGS:

- City of Manitou Springs
- Archuleta County
- Pitkin County
- San Luis Valley Region (Alamosa, Conejos, Costilla, Mineral, Rio Grande and Saguache)

Data we are looking for include landslide, rockfall, debris flow, unstable soils, expansive soils, and earthquakes (faults, liquefaction). I may have most of this data but it would be good to know if I have the latest and or if something shouldn't be used. I recently went to the CGS website to obtain layers that were in Manitou Springs' last plan but the GIS data is only viewable through your service and not for download. I am connected to the CGS GIS Server through ArcMap but these layers are only for viewing as well.

Here are 2 layers I was trying to obtain for Manitou Springs.

<https://coloradogeologicalsurvey.org/publications/debris-flow-susceptibility-map-colorado/>

<https://coloradogeologicalsurvey.org/publications/landslide-inventory-el-paso-colorado/>

We are looking to have the data by the end of May.

Thank you,

Mack Chambers
GIS Analyst
Mobile: (720) 839-1516
www.woodplc.com

wood.

Hazard Mitigation Plan Update Public Engagement June 30, 2022-May 4, 2023

The Westminster Emergency Management Coordinator Facebook was used to promote awareness and invite public input into the HMP-Update process. The following documents the use of social media and the results of this effort. The City of Westminster Emergency Management Facebook is available at <https://www.facebook.com/Cityofwestminsteremergencymanagement/>

Summary

Post Date	Reaches	Engagement	
26-Apr	1,632	154	Understanding floodzones
13-Apr	7,340	366	Apr 8 drought outreach event video
30-Mar	5,855	302	Invitation to Apr 8 outreach event-Drought, Irving St Library
25-Feb	3,996	530	EMC flood preparedness video
25-Feb	5,395	78	Feb 11 flood mitigation and prep video/library event
6-Feb	1,634	143	Invitation to the Feb 11 Outreach event, Irving St Library
12-Jan	6,640	1,402	Link to public survey on hazards
5-Dec	2,501	300	Invitation to the public
24-Oct	128	3	Invitation to the public
20-Sep	1,400	1,420	EMC Wind-driven fire risk assessment video
19-Sep	3,187	2,446	Sep 17 wind-driven fire video/library event
15-Sep	1,422	42	Invitation to Sep 17 wind-driven fire event, College Hill Library
14-Sep	4,694	1,224	Invitation to Sep 17 wind-driven fire event, College Hill Library
1-Sep	2,693	481	Invitation to Sep 17 wind-driven fire event, College Hill Library
30-Jun	2,484	474	Invitation to the public
Total	51,001	9,365	

City of Westminster Emergency Management
 Published by Westy Prepared · April 26 at 3:57 PM · 🌐

A 2020 nationwide flooding study found that 84.5 percent of flood damages occurred outside high flood risk areas. You cannot assume your home or business is safe from flood damage just because you are not in a floodplain. This video has some great guidance to help you find out more about your flood risk and what you can do to mitigate it. You can also find out whether your Westminster home is in a floodplain, and resources and tips to keep you safe on our website: <https://www.cityofwestminster.us/.../FloodplainManagement> Be aware, be prepared, and please be safe.

YOUTUBE.COM
FEMA's Flood Insurance Advocate Explains Flood Risk
 FEMA's Office of the Flood Insurance Advocate created this video to help the public better un...

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Post Impressions ⓘ

2,189

Post reach ⓘ

1,632

Post Engagement ⓘ

154

Boosted on Apr 26, 2023

Status: **Active** · Boosted by: Westy Prepared
 Budget: \$50.00 lifetime · Duration: 9 days

Post reach ⓘ

1,898

Post Engagement ⓘ

155

City of Westminster Emergency Management
 Published by Westy Prepared · April 13 at 3:40 PM · 🌐

A huge "thank you!" to the residents, HOAs, and City staff who participated in our third West Prepared community hazard, mitigation, and preparedness event on April 8. Drought was the topic this time and we had our best participation to date. A video of our drought discussion is posted below. The Planning for Drought begins the presentations. The Trees and Drought discussion begins at 25 minutes, followed by Alternative Landscapes at 42 minutes, and Drought Mitigation at 1:17... [See more](#)

0:11 / 1:43:22

See insights and ads Boost again

👍 9 9 comments 2 shares

👍 Like 💬 Comment ➦ Share

Post Insights ✕

A huge "thank you!" to the residents, HOAs, and City staff who participated in our third West Prepared...
 Published by Westy Prepared · April 13 at 3:40 PM · 🌐

Post Impressions ⓘ 15,830	Post reach ⓘ 7,340	Post Engagement ⓘ 366
-------------------------------------	------------------------------	---------------------------------

Views ⓘ

👤 3-Second Video Views	7,067
🎬 1-minute video views	195
🎞️ Average minutes viewed	0:12

Interactions ⓘ

👍	❤️	😂	😱	😓	😡
10	0	0	0	0	0



City of Westminister Emergency Management

Published by Westy Prepared · March 30 at 4:57 PM ·

Drought is one of Westminister's most persistent natural hazards. Please join us in person or virtually at our next community hazard awareness and mitigation discussion at Irving Street Library, April 8, 11:00-12:30 pm. You will have a chance to hear from City of Westminister staff about this hazard, its potential impact on our community, and what we can do to mitigate the effects of drought. We are also seeking public input on the 5-year update to our Hazard Mitigation Plan. Please visit <https://westminsterlibrary.evanced.info/signup/calendar> to register and receive updates and a Zoom link if you would like to attend virtually.



City of Westminister Emergency Management

The intent of this page is to empower our citizens with the information they need to be part of...

No insights to show

117

12 comments



Drought is one of Westminister's most persistent natural hazards. Please join us in person or virtually at our next...

Published by Westy Prepared · March 30 ·

Post Impressions ⓘ

9,182

Post reach ⓘ

5,855

Post Engagement ⓘ

302

Distribution ⓘ

+6.4x more impressions than your other posts within 21+ days of publishing. [Learn more](#)

Interactions ⓘ



116



2



1



1



1



0

City of Westminster Emergency Management
 Published by Westy Prepared · February 25 at 2:10 PM · 🌐

Westminster Emergency Management and our libraries have teamed up with local subject matter experts to offer a series of presentations on our local hazards, mitigation efforts, and community preparedness. So far, we have discussed the wind-driven fire and flooding hazards. The following video is based on the flood hazard overview that was recently presented at Irving Street Library. We plan to discuss drought in April, cyber-attack in June, and community hazardous materials in August. Each of these hazards presents unique dangers for our community and each requires specific mitigation efforts. Regardless of the hazard, preparedness depends on awareness of the hazards, being signed up for LookoutAlert, having a plan, and having a go-kit. To learn more and to register for future events, please visit <https://westminsterlibrary.evanced.info/signup/calendar...> Also, watch this page and visit <https://www.cityofwestminster.us/emergencymanagement> for more information. Be aware, be prepared, and please stay safe.

Greg Moser
 Emergency Management Coordinator
 February 11, 2023

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👍 12 5 shares

Post Insights

Westminster Emergency Management and our libraries have teamed up with local subject matter experts to off...
 Published by Westy Prepared · February 25 · 🌐

Post Impressions ⓘ
5,857

Post reach ⓘ
3,996

Post Engagement ⓘ
530

Views ⓘ

👤 3-Second Video Views 3,620

🎬 1-minute video views 76

🎞️ Average minutes viewed 0:11

Interactions ⓘ

👍 20 ❤️ 0 😂 0 😱 0 😭 0 😡 0

City of Westminster Emergency Management
 Published by Westy Prepared · 2d ·

A big "thank you" to everyone who joined us in person or virtually at the Irving Street Library on February 11, to discuss our community flood hazard. The following is the recording of the presentations on storm water management, the flood hazard, and our mitigation plan update. On April 8, we plan to discuss the drought hazard. You can register for this upcoming event at <https://westminsterlibrary.evanced.info/signup/calendar...> Be aware, be prepared, and please stay safe!

See insights and ads Boost again

👍 3 3 comments

Post Insights ✕

A big "thank you" to everyone who joined us in person or virtually at the Irving Street Library on February 11, to...
 Published by Westy Prepared · February 25 ·

Post Impressions ⓘ	Post reach ⓘ	Post Engagement ⓘ
9,841	5,395	78

Views ⓘ

3-Second Video Views	4,563
1-minute video views	130
Average minutes viewed	0:10

City of Westminster Emergency Management
 Published by Westy Prepared · February 6 at 10:04 AM · 🌐

Are you interested in learning more about the flood hazard in Westminster and what is being done to mitigate it? Please join Westminster Community Development and Emergency Management staff to learn more. It is easy to register for updates and Zoom access to this event at <https://westminsterlibrary.evanced.info/signup/calendar> Be aware, be prepared, and please be safe!



WESTY PREPARED SERIES
 Preparedness is a shared responsibility of the City and its residents! This program introduces participants to all-community hazards, as well as mitigation and preparedness efforts.

FLOOD AWARENESS: SATURDAY, FEB. 11
 11:00-12:30 PM, Irving Street Library Community Room

DROUGHT AWARENESS: SATURDAY, APRIL 8
 11:00-12:30 PM, Irving Street Library Community Room


Can't attend in-person?
 Register online to receive a Zoom invitation!

See insights and ads Boost again

👍 57 1 comment 17 shares

Seven people attended this event (six virtual)

Post Insights ✕

 Are you interested in learning more about the flood hazard in Westminster and what is being done to...
 Published by Westy Prepared · February 6 · 🌐

Post Impressions ⓘ	Post reach ⓘ	Post Engagement ⓘ
2,619	1,634	143

Distribution ⓘ

📉 -2.0x less impressions than your other posts within 21+ days of publishing. [Learn more](#)

Interactions ⓘ

👍	❤️	😄	😱	😭	😡
64	1	2	0	0	0



City of Westminster Emergency Management

Published by Westy Prepared · January 11 at 4:37 PM ·



We still need your input on Westminster's natural hazards risk assessment and our mitigation plan. Please follow this link to complete a short survey. <https://forms.office.com/r/jcKNNLbmt5>

The survey has 7 questions and only takes about 5 minutes. The purpose of this survey is to solicit public input on hazards of concern and suggestions for reducing the impacts of hazards before they occur. The survey is open till January 31, 2023. We plan to have a public meeting later this year to review and discuss survey results and the draft plan. If you would like to be added to the contact list, please provide your email address to gmoser@cityofwestminster.us for future notifications and invitations. Thanks in advance!

Natural Hazard/Threat Summary							
Likelihood	Most	E	<ul style="list-style-type: none"> Windstorm 	<ul style="list-style-type: none"> Lightning Hail 	<ul style="list-style-type: none"> Severe Winter Storm 	<ul style="list-style-type: none"> Invasive & Noxious Species Climate Change Drought 	
	D	<ul style="list-style-type: none"> Open Space Fire 		<ul style="list-style-type: none"> Extreme Cold 	<ul style="list-style-type: none"> Drainage Flooding 		
	C				<ul style="list-style-type: none"> Street Flooding 		
	B		<ul style="list-style-type: none"> Extreme Heat 		<ul style="list-style-type: none"> Tornado 	<ul style="list-style-type: none"> Pandemic 	
	Least	A		<ul style="list-style-type: none"> Earthquake 		<ul style="list-style-type: none"> Geomagnetic Storm 	
			1	2	3	4	5
			Lowest	Consequences			Highest



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👍👏 62

45 comments 12 shares

Post Insights



Total Insights

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Post Impressions ⓘ

12,088

Post reach ⓘ

6,640

Post Engagement ⓘ

1,402

Boosted on Jan 12, 2023

Status:Completed · Boosted by: Westy Prepared
Budget: \$50.00 lifetime · Duration: 19 days



Post reach ⓘ


6,258

Post Engagement ⓘ

0


City of Westminster Emergency Management
Published by Westy Prepared · December 5, 2022 at 12:54 PM · 🌐

Take Our Survey On Hazards!
The City of Westminster is in the process of updating its Hazard Mitigation Plan in 2023, building upon a prior version of the plan updated in 2018. The Hazard Mitigation Plan analyzes the City's vulnerabilities to natural and human-caused hazards and identifies mitigation actions that can be taken to minimize property damage and reduce the loss of life by lessening the impacts of disasters. The purpose of this survey is to solicit public input on... See more



City of Westminster Hazard Mitigation Plan

June 2018



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👍❤️ 65 10 comments 10 shares

Post Insights

Total Insights

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Post Impressions ⓘ

4,203

Post reach ⓘ

2,501

Post Engagement ⓘ

300

Boosted on Dec 5, 2022

Status: Completed · Boosted by: Westy Prepared
Budget: \$54.00 lifetime · Duration: 15 days

Post reach ⓘ

2,283

Post Engagement ⓘ

0

City of Westminster Emergency Management
Published by Westy Prepared · October 24, 2022 · 🌐

If you would like to help us update our Hazard Mitigation Plan, please send an email to gmoser@cityofwestminster.us to be added to the list for invitations and updates. Our 2018 plan can be reviewed at https://www.cityofwestminster.us/_/Westminster%202018...

Volunteers Needed!

		Natural Hazards Relative Risk Rating				
		1	2	3	4	5
Likelihood	Most	• Windstorm	• Lightning • Hail • Swelling Soils • Radon	• Severe Winter Storm	• Invasive & Noxious Species	• Climate Change • Drought
	D		• Open Space Fire	• Extreme Cold • Extreme Heat	• Drainage Flooding • Erosion & Turbidity	
C				• Street Flooding		
B				• Tornado	• Pandemic	
A			• Earthquake		• Geomagnetic Storm	
		Lowest	Consequences		Highest	

Who wants to help update our community Hazard Mitigation Plan? We do this every five years and we need your input. You are invited to attend in-person and virtual meetings to evaluate our natural hazards and identify projects to make Westminster safer and more resilient.

Please sign-up or send an email to gmoser@cityofwestminster.us to be added to our meeting updates and invitation list.

Post Insights

Total Insights

See more details about your post.

Post Impressions ⓘ

132

Post reach ⓘ

128

Post Engagement ⓘ

3

City of Westminster Emergency Management
Published by Westy Prepared · September 20, 2022 ·

How would you rate wind-driven fire as a Westminster community hazard? Please review this video and tell us what you think. How likely and how severe would a wind-driven fire be? What can we do to mitigate this hazard? Please put your score, comments and mitigation recommendations in the comments section of this post. It is a critical part of our ongoing community risk assessment. Watch for more hazard assessment surveys. If you would like to be included in our community miti... See more

Community Hazard Risk Scoring and Mitigation
Wind-Driven Fire

Westminster Hazard Mitigation Plan-Update 2023

0:07 / 1:10

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2 1 comment 2 shares

Like Comment Share

Post Insights

Total Insights
See more details about your post.

Post Impressions	Post reach	Post Engagement
1,583	1,400	264

Boosted on Sep 20, 2022
Status:Completed • Boosted by: Westy Prepared
Budget: \$35.00 lifetime • Duration: 7 days

Post reach	Post Engagement
1,261	1,156

City of Westminster Emergency Management
Published by Westy Prepared · September 19, 2022 ·

Thank you to everyone who joined us in person or virtually for our first Community Hazards Awareness, Mitigation, and Preparedness event on Saturday. Your time and input are greatly valued and we hope you will join us for future events. Our next discussion will be the flood hazard on February 11, 10-11:30, at the Irving Street Library. Please watch for updates. For those of you who are new to the group, I wanted to let you know that these events will not be your only opportunity to provide input on our natural Hazard Mitigation Plan (HMP). We are just kicking-off the plan update and will hold at least one larger, general public event to discuss all of our hazards and mitigation strategies. The attached is a recording of Saturday's presentation on wind-driven fire and Firewise. Representatives from WFD discuss the Marshall Fire from 0:00 to 22:26. A representative from Open Space discusses open space mitigation from 22:26-29:00, and the preparedness and mitigation run from 29:00. Please watch for more Firewise specific information on this page. Be aware, be prepared, and please be safe.

MARSHALL FIRE - WESTMINSTER'S RESPONSE

September 17, 2022
Fire Department Staff Presentation Presented by
David Varney - Battalion Chief
Eric Linnenburger - Battalion Chief

1:58 / 55:51

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12 1 comment 4 shares

Post Insights

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Post Impressions	Post reach	Post Engagement
5,521	3,187	89

Boosted on Sep 19, 2022
Status:Completed • Boosted by: Westy Prepared
Budget: \$25.00 lifetime • Duration: 7 days

Post reach	Post Engagement
3,163	2,357

City of Westminster Emergency Management
Published by Westy Prepared · September 15, 2022 ·

Our first Community Hazard Awareness, Mitigation and Preparedness event will be held at the College Hill Library, 3705 W 112th Ave. Saturday, Sep. 17, 10-11:30am. You are invited to attend in-person or virtually. The link for virtual attendance is <https://us02web.zoom.us/j/83266951847...> Wind driven fire is the topic of this event. Representatives from Westminster Fire, Open Space and Emergency Management will share their experiences from the Marshall fire and information on fire mitigation and preparedness. We are requesting that you register (see the Sep 17 Firewise event at <https://westminsterlibrary.evanced.info/signup/calendar...>) so we can plan and send updates if needed. We hope you can join us for this and future events. Be aware, be prepared and please stay safe.



HOME IGNITION ZONE CHECKLIST

EMERGENCY PREPAREDNESS: A HOME CHECKLIST FROM WESTMINSTER FIRE DEPARTMENT

1. Check roof and gutters of your home. Make sure they are clean and free of debris.
2. Remove or trim any trees and shrubs near your home.
3. Remove leaves and twigs from your roof.
4. Clean gutters and downspouts.
5. Check for leaks and make sure they are repaired.
6. Check for leaks and make sure they are repaired.
7. Check for leaks and make sure they are repaired.
8. Check for leaks and make sure they are repaired.
9. Check for leaks and make sure they are repaired.
10. Check for leaks and make sure they are repaired.

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Post Impressions	Post reach	Post Engagement
1,512	1,422	42

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City of Westminster Emergency Management
Published by Westy Prepared · September 14, 2022 ·

The Marshall Fire clearly demonstrated the danger of wind-driven fire in the Front Range. Since then, many people have asked about this hazard in Westminster and what we can do to mitigate it. These are exactly the questions we want to discuss at our first Community Hazard Awareness, Mitigation and Preparedness discussion at College Hill Library, 10-11:30am, Saturday, September 17. This is your chance to learn more about the Marshall Fire and role of the Westminster Fire Department in protecting our community. We will also discuss what you can do to protect your home and business. Westminster Libraries, Emergency Management and other departments and community partners are planning to host a series of every-other-month public events to discuss our community hazards and how we can make Westminster a safer, more resilient and more prepared community. Please register at <https://westminsterlibrary.evanced.info/signup/calendar> so we can send updates and plan this event. Events in 2023 will look at the hazard and mitigation options associated with flooding, drought, cyber threats, and community hazardous materials. Please join us if you can, and as always, be aware, be prepared, and please be safe.



Marshall Fire December 30, 2021

- 6,025 acres
- 1,778 homes within the perimeter
- Shopping center
- Hotel
- 50-100 mph winds

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71 16 comments 17 shares

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Post Impressions	Post reach	Post Engagement
5,548	4,694	1,009

Boosted on Sep 14, 2022
Status: Completed · Boosted by: Westy Prepared
Budget: \$20.00 lifetime · Duration: 3 days

Post reach	Post Engagement
3,560	215

City of Westminster Emergency Management
Published by Westy Prepared • September 1, 2022

Would you like to know more about our community hazards and what is being done to mitigate and prepare for them? Westminster's libraries, emergency management and other city departments are teaming up to host a community discussion every other month. Our first one will be held at College Hill Library, 10-11:30am, Saturday, September 17. Westminster firefighters will share their experiences during the Marshall Fire and we will discuss how Firewise practices can help us mitigate the wind-driven community fire hazard. Subsequent discussions of flooding, drought and cyber attack are also being planned. You can attend in person or virtually, but we request you register at <https://westminsterlibrary.advancedinfo@groups/calendar> so we can send updates and the link for virtual attendance. As always, be aware, be prepared and please be safe.

FIREWISE PRESENTATION

Improve awareness of fuel sources on properties, plan for sheltering and evacuating, create preparedness kits and learn about the Lookout Alert emergency notification system.

SATURDAY, SEPTEMBER 17
10-11:30 A.M.
COLLEGE HILL LIBRARY
3705 W 112TH AVE.

AGE 18+

REGISTER ONLINE
WWW.WESTMINSTERLIBRARY.ORG




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74 3 comments 15 shares

Like Comment Share

Post Insights ✕

Total Insights
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Post Impressions i	Post reach i	Post Engagement i
4,378	2,693	192

Boosted on Sep 9, 2022
Status:Completed-Boosted by: Westy Prepared
Budget: \$35.00 lifetime • Duration: 7 days


Post reach i	Post Engagement i
1,140	141

Boosted on Sep 1, 2022
Status:Completed-Boosted by: Westy Prepared
Budget: \$35.00 lifetime • Duration: 7 days

Post reach i	Post Engagement i
1,330	148


City of Westminster Emergency Management
Published by Westy Prepared • June 30, 2022

Who wants to help update the City of Westminster Hazard Mitigation Plan? We do this every five years and we need your participation and input. We will have in person and virtual meetings to evaluate our natural hazards and to identify projects to help make Westminster safer and more resilient. If you are a Westminster resident and would like to participate in our Hazard Mitigation Plan update, give this post a 👍 and I will DM and add you to our community mitigation team. You can review our 2018 Hazard Mitigation Plan at <https://www.cityofwestminster.us/Portals/1/Documents/Public%20Safety%20-%20Documents/Emergency%20Management/Westminster%202018%20HMP%20Update-Final%20Aug%202018.pdf?ver=2018-10-10-102858-093> Thanks in advance!



City of Westminster Hazard Mitigation Plan

June 2018



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76 8 comments 8 shares

Post Insights ✕

Total Insights
See more details about your post

Post Impressions i	Post reach i	Post Engagement i
3,929	2,484	286

Boosted on Jun 30, 2022
Status:Completed-Boosted by: Westy Prepared
Budget: \$50.00 lifetime • Duration: 7 days

Post reach i	Post Engagement i
2,251	188

From: [Moser, Greg](#)
To: [christopher.johnson](#)
Subject: FW: Community Hazards Survey
Date: Monday, December 5, 2022 2:15:00 PM
Attachments: [image001.png](#)

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Christopher,

I sent the request to the HMP committee and to residents who have expressed interest. I have also posted it on Facebook at <https://www.facebook.com/Cityofwestminsteremergencymanagement/>. I promoted it on Facebook and will provide a summary of the number of reaches and reactions.

Best Regards,

Greg Moser (he/his)
Emergency Management Coordinator
City of Westminster | Fire Department
gmoser@CityofWestminster.us | 303.658.4550
9110 Yates Street, Westminster, CO 80031



<https://www.cityofwestminster.us/emergencymanagement>

From: Moser, Greg <gmoser@CityofWestminster.us>
Sent: Monday, December 5, 2022 1:08 PM
Cc: Angel Ferns (angelsferns@gmail.com) <angelsferns@gmail.com>; Anna Neidig (annabneidig@yahoo.com) <annabneidig@yahoo.com>; Anna Yoder (ayodera@gmail.com) <ayodera@gmail.com>; Archuleta, Jacob <jarchuleta@americanrenal.com>; Brian Templeman <brian_templeman@hotmail.com>; Carol Hendrix (clhhendrix@gmail.com) <clhhendrix@gmail.com>; Carol Thompson (carolann65@yahoo.com) <carolann65@yahoo.com>; Charles and Angelina Bagalow (xmasangieb@aol.com) <xmasangieb@aol.com>; Christopher Mead <chrismead2009@hotmail.com>; David Dunn (ddunn_88@yahoo.com) <ddunn_88@yahoo.com>; Deb Oster <doster0406@msn.com>; Deb Rinkenberger (Deb.Morrell.0767@gmail.com) <Deb.Morrell.0767@gmail.com>; Diana Herron (diana.herron@gmail.com) <diana.herron@gmail.com>; Diane Edes <dianee229@gmail.com>; Erica Forrette <elf2588@gmail.com>; Erin Dahl McCausey (emccaus@gmail.com) <emccaus@gmail.com>; Faye Heimerl (fqhbooks@comcast.net) <fqhbooks@comcast.net>; Glenn Wiczorek

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Subject: Community Hazards Survey

Please take Our Survey On Hazards!

The City of Westminster is in the process of updating its Hazard Mitigation Plan in 2023, building upon a prior version of the plan updated in 2018. The Hazard Mitigation Plan analyzes the City's vulnerabilities to natural and human-caused hazards and identifies mitigation actions that can be

taken to minimize property damage and reduce the loss of life by lessening the impacts of disasters. The purpose of this survey is to solicit public input on hazards of concern and suggestions for reducing the impacts of hazards before they occur. The survey has 7 questions and only takes about 5 minutes.

The survey is open till December 31, 2022. <https://forms.office.com/r/jcKNNLbmtS>

Thanks in advance!

Greg Moser (he/his)

Emergency Management Coordinator

City of Westminster | Fire Department

gmoser@CityofWestminster.us | 303.658.4550

9110 Yates Street, Westminster, CO 80031



WESTMINSTER | WWW.CITYOFWESTMINSTER.US

<https://www.cityofwestminster.us/emergencymanagement>

City of Westminster Hazard Mitigation Plan Public Input Survey

The City of Westminster is updating its Hazard Mitigation Plan in 2023 per the five-year update cycle required of FEMA and the Federal Disaster Mitigation Act of 2000.

The Hazard Mitigation Plan analyzes the City's vulnerabilities to natural and human-caused hazards and identifies mitigation actions that can be taken to minimize property damage and reduce the loss of life by lessening the impacts of disasters.

The purpose of this survey is to collect information from the public and stakeholders to better understand the vulnerabilities within the City of Westminster as well as solicit input on needs to best mitigate, or reduce, the impacts of hazards before they occur.

Please complete this survey by **December 31, 2022**.

* Required

Hazard Significance

1. The natural hazards addressed in the Westminster Hazard Mitigation Plan update are listed below. Please indicate the level of significance in the City that you perceive for each hazard. *

	Low	Medium	High
Dam Failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drought and Water Security	<input type="radio"/> Low	<input type="radio"/> Medium	<input type="radio"/> High

Earthquake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Epidemic/Pandemic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme Cold	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme Heat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flooding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hail	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invasive and Noxious Species	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Severe Summer Storms and Lightning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Severe Winter Storms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Solar/Geomagnetic Storms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swelling Soils	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tornado	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Open Space/Wind-Driven Fire	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Windstorm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Erosion & Deposition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Are there any hazards not listed that the planning committee should consider? (note: the focus of the plan is on natural hazards, however the City also plans for a variety of human caused hazards.)

Specific Hazard Issues/Problems

3. How many times has a natural hazard disrupted your daily life in the last five years?

- 0
- 1-2
- 3-5
- More than 5 times

4. Do you have information on specific hazard issues/problem areas that you would like the planning committee to consider? Note the specific area in the City.

Mitigation Activities

5. Mitigation is actions that can be taken to reduce or eliminate the long-term risk to hazards.

The following types of mitigation actions may be considered by the City. Please indicate the types of mitigation actions that you think should have the highest priority in the City of Westminster Hazard Mitigation Plan. *

- Indoor/Outdoor Warning
- Wildfire Fuels Treatment projects
- Assistance with Defensible Space
- Continued Participation in the National Flood Insurance Program
- Critical Facilities Protection
- Generators for Critical Facilities
- Planning/Zoning to avoid future development impacts
- Public Education/Awareness
- Stormwater Drainage Improvements
- Forest Health/Watershed Protection
- Flood Mitigation
- Education and Discounts on Flood Insurance
- Floodprone Property Buyout
- Water Conservation
- Evacuation route development
- Dam safety
- Improve reliability of communications systems
- Lightning protection for critical facilities

Public health incident preparedness

Hazardous tree management

Invasive species removal

Pre-Disaster Strategies

6. Please comment on any other pre-disaster strategies that the planning committee should consider for reducing future losses caused by natural disasters:

Contact Information

7. Optional: Provide your name and email address if you would like to be added to a distribution list for upcoming activities related to the planning process:

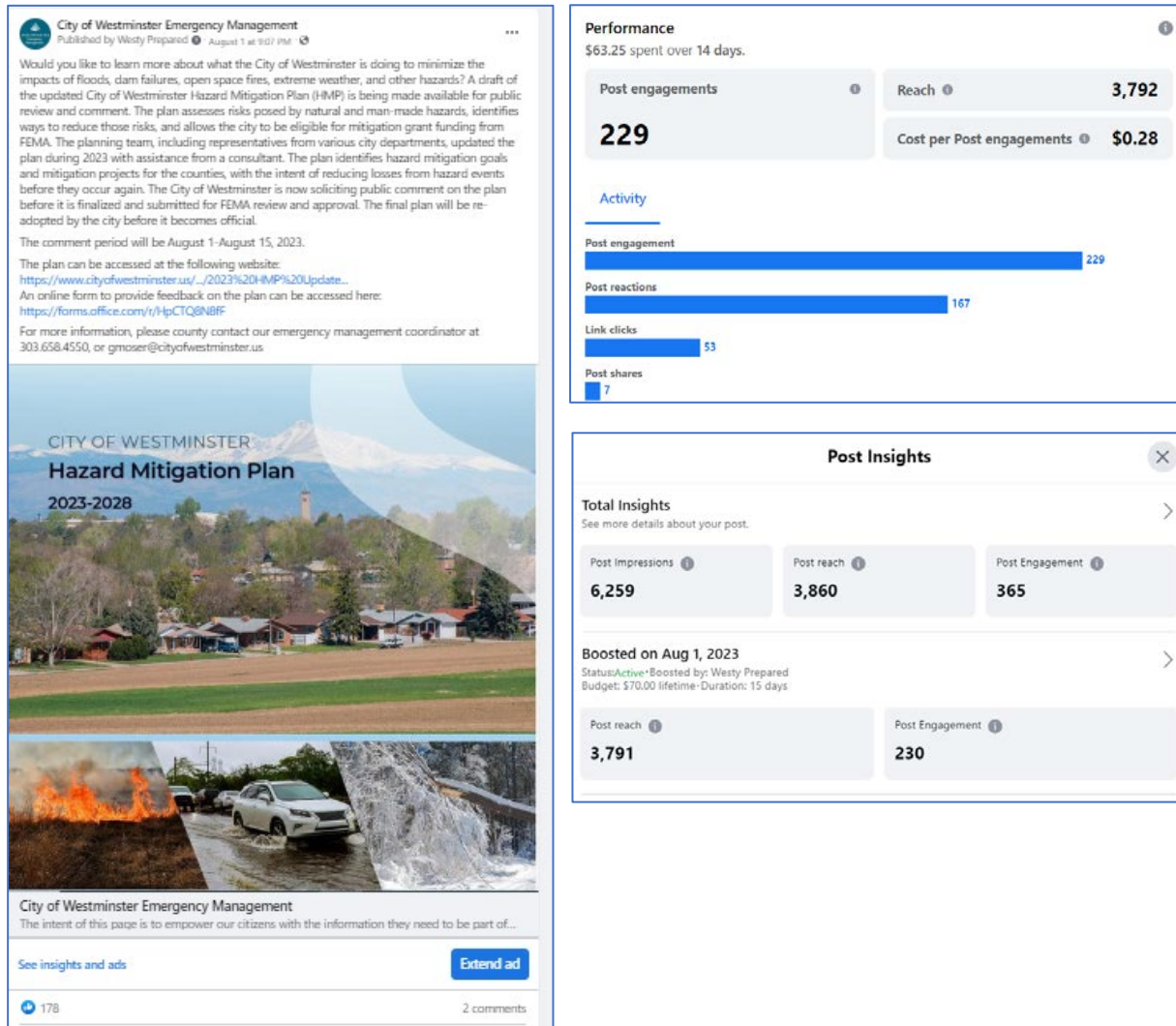
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Public Review and Comment Solicitation August 1-15, 2023

The draft HMP-Update and link to provide feedback were posted for public review and comment on the City of Westminster Emergency Management website at <https://www.cityofwestminster.us/emergencymanagement>

The link to the draft HMP-Update and feedback form were also posted on the posted on the City of Westminster Emergency Management Facebook page. The promotion of this post provided the following results as of August 15, 2023.



From: [Moser, Greg](#)
To: "[Brislawn, Jeff P.](#)"; [Bruce Rindahl](#); [Hawthorn, Andrew](#); [Hose, Bob](#); [Hufford, Brock](#); [Krugmire, Bob](#); [Mitchell, Lara](#); [Martinez, Amanda](#); [McCoy, Bryan](#); [irene.merrifield](#); [Moser, Greg](#); [Nims, Josh](#); [Otterstetter, Heather](#); [Parlow, Mikeal](#); [Plas, Seth](#); [Redmer, Kit](#); [Schmiechen, Paul](#); [Song, Andrea](#); [Tomlin, Bridger](#); [Troller, Stephanie](#); [Walls, Rob](#); [Wood, Shelby](#)
Cc: [Johnson, Christopher](#); [Brislawn, Jeff](#); [Nelson, Cameron](#); [Field, Scott](#)
Subject: FW: [EXTERNAL] Westminster HMP Base Plan Chapters
Date: Wednesday, June 14, 2023 4:04:04 PM
Attachments: [image001.png](#)
[image002.png](#)
[2023 HMP Update Base Plan 6-14-2023.docx](#)

Good Afternoon All,
Please review the attached and provide feedback NLT June 29 to the WSP team.

Thanks in advance,

Greg Moser (he/his)
Emergency Management Coordinator
City of Westminster | Fire Department
gmoser@CityofWestminster.us | 303.658.4550 (o) 303.589.7812 (m)
9110 Yates Street, Westminster, CO 80031



<https://www.cityofwestminster.us/emergencymanagement>

From: Johnson, Christopher <christopher.johnson@wsp.com>
Sent: Wednesday, June 14, 2023 2:56 PM
To: Moser, Greg <gmoser@CityofWestminster.us>
Cc: jeff.brislawn@wsp.com; Schoen, Natalie <natalie.schoen@wsp.com>; Nelson, Cameron <cameron.nelson@wsp.com>; Field, Scott <scott.field@wsp.com>
Subject: [EXTERNAL] Westminster HMP Base Plan Chapters

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Greg,

I have attached for your review the HMPC draft of the 2023 City of Westminster HMP. This includes all of the chapters except for the HIRA; I am still working through a QC review of that and should have it ready for you by the end of the week. Please push this out to all members of the HMPC that have been involved in the update process so that we can gather any input and comments on the draft. We would like a 2-week review period, so if you can instruct everyone to please send their comments back by **6-29-2023**. Folks can send us back this word document with their comments saved showing Track Changes, send comments back in an email, or any other format that works best. Please also include me on the email when you send this out the HMPC so that I can save it for documentation purposes.

Please let me know if you have any questions, or if you would like a PDF version of the plan as well to send out.
Thank you!



Christopher Johnson
Consultant – Environmental Planner

He/Him/His

WSP USA
2000 S. Colorado Blvd., Ste. 2-1000
Denver, CO 80222

wsp.com

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-LAEmHhHzdJzBITWla4Hgs7pbKI

RESOLUTION

RESOLUTION NO. **34**

INTRODUCED BY COUNCILLORS

SERIES OF 2023

DeMott, Nurmela

A RESOLUTION ADOPTING THE CITY OF WESTMINSTER'S HAZARD MITIGATION PLAN

WHEREAS, the City of Westminster, Colorado, with assistance from WSP USA Environment & Infrastructure Inc., has gathered information and prepared the City of Westminster Hazard Mitigation Plan; and

WHEREAS, the City of Westminster Hazard Mitigation Plan has been prepared and updated in accordance with FEMA requirements at 44 C.F.R. 201.6 and Colorado Division of Homeland Security and Emergency Management additional State requirements; and

WHEREAS, the City of Westminster is a local unit of government that has afforded the citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and

WHEREAS, City Council has reviewed the Plan and affirms that the Plan will be updated no less than every five years.

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

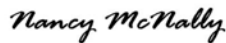
that the City of Westminster adopts the City of Westminster Hazard Mitigation Plan, and resolves to execute the actions in the Plan.

PASSED AND ADOPTED this 13th day of November, 2023.

ATTEST:



City Clerk



Mayor

APPROVED AS TO LEGAL FORM:



City Attorney's Office

APPENDIX D MITIGATION CATEGORIES, ALTERNATIVES, AND SELECTION CRITERIA

D.1 Categories of Mitigation Measures Considered

As part of the process of developing the mitigation action plans found in Chapter 5, the HMPC reviewed and considered a comprehensive range of mitigation options before selecting the actions identified for implementation. This section summarizes the full range of mitigation measures evaluated and considered by the HMPC, including a review of the categories of mitigation measures outlined in the 2017 CRS Coordinator's Manual and its 2021 Addendum, a discussion of current local implementation and CRS credits earned for those measures, and a list of the specific mitigation projects considered and recommended for implementation.

Mitigation alternatives identified for implementation by the HMPC were evaluated and prioritized using the criteria discussed in Section 4 of this plan.

The following categories are based on the Community Rating System.

1. Prevention
2. Property Protection
3. Natural Resource Protection
4. Structural Projects
5. Emergency Services
6. Public Information and Outreach

D.2 Alternative Mitigation Measures per Category

Prevention

Preventative measures are designed to keep a problem - such as flooding - from occurring or from getting worse. The objective of preventative measures is to ensure that future development is not exposed to damage and does not cause an increase in damages to other properties. Building, zoning, planning and code enforcement offices usually administer preventative measures. Some examples of types of preventative measures include:

- Building codes
- Zoning ordinance
- Comprehensive or land use plan
- Open space preservation
- Floodplain regulations
- Subdivision regulations
- Stormwater management regulations

BUILDING CODES

Building codes provide one of the best methods for addressing natural hazards. When properly designed and constructed according to code, the average building can withstand many of the impacts of natural hazards. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Building codes can ensure that the first floors of new buildings are constructed to be higher than the elevation of the 100-year flood (the flood that is expected to have a one percent chance of occurring in any given year). This is shown in the Risk Assessment Annex under the flood hazard section.

Just as important as having code standards is the enforcement of the code. Adequate inspections are needed during construction to ensure that the builder understands the requirements and is following them. Making sure a structure is properly elevated and anchored requires site inspections at each step.

ASCE 24 is a referenced standard in the International Building Code. Any building or structure that falls within the scope of the IBC that is proposed in a flood hazard area is to be designed in accordance with ASCE 24. Freeboard is required as a function of the nature of occupancy and the flood zone. Dwellings and most other buildings have 1-foot of freeboard; certain essential facilities have 2-3 feet; only agricultural facilities, temporary facilities and minor storage facilities are allowed to have their lowest floors at the BFE.

COMPREHENSIVE OR LAND USE PLAN

Building codes provide guidance on how to build in hazardous areas. Planning and zoning activities direct development away from these areas, particularly floodplains and wetlands. They do this by designating land uses that are compatible with the natural conditions of land that is prone to flooding, such as open space or recreation.

OPEN SPACE PRESERVATION

Keeping the floodplain and other hazardous areas open and free from development is the best approach to preventing damage to new developments. Open space can be maintained in agricultural use or can serve as parks and greenway corridors.

Comprehensive and capital improvement plans should identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced, or a payment is made to the owner if the owner agrees to not build on the part set aside in the easement.

Although there are some federal programs that can help acquire or reserve open lands, open space lands and easements do not always have to be purchased. Developers can be encouraged to dedicate park land and required to dedicate easements for drainage and maintenance purposes.

ZONING ORDINANCE

Zoning enables a community to designate what uses are acceptable on a given parcel. Zoning can ensure compatibility of land use with the land's level of suitability for development. Planning and zoning activities can also provide benefits by allowing developers more flexibility in arranging improvements on a parcel of land through the planned development approach. Zoning regulations describe what type of land use and specific activities are permitted in each district, and how to regulate how buildings, signs, parking, and other construction may be placed on a lot. Zoning regulations also provide procedures for rezoning and other planning applications. The zoning map and zoning regulations provide properties with certain rights to development.

FLOODPLAIN REGULATIONS

A Flood Damage Prevention Ordinance sets development standards for Special Flood Hazard Areas (SFHAs). Communities participating in the National Flood Insurance Program (NFIP) are required to adopt a flood damage prevention ordinance that meets at least the minimum standards of the NFIP; however, a community can incorporate higher standards for increased protection. For example, communities can adopt higher regulatory freeboard requirements, cumulative substantial damage definitions, fill restrictions, and other standards.

Another important consideration in floodplain regulations is the protection of natural and beneficial functions and the preservation of natural barriers such as vegetation. Vegetation along a stream bank is extremely beneficial for the health of the stream. Trees and other plants have an extensive root system that strengthen stream banks and help prevent erosion. Vegetation that has sprouted up near streams should remain undisturbed unless removing it will significantly reduce a threat of flooding or further destruction of the stream channel.

STORMWATER MANAGEMENT REGULATIONS

Stormwater runoff is increased when natural ground cover is replaced by urban development. Development in the watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality. There are three ways to prevent flooding problems caused by stormwater runoff:

1. Regulating development in the floodplain to ensure that it will be protected from flooding and that it will not divert floodwaters onto other properties;
2. Regulating all development to ensure that the post-development peak runoff will not be greater than it was under pre-development conditions; and
3. Set construction standards so buildings are protected from shallow water.

REDUCING FUTURE FLOOD LOSSES

Zoning and comprehensive planning can work together to reduce future flood losses by directing development away from hazard prone areas. Creating or maintaining open space is the primary way to reduce future flood losses.

Planning for open space must also be supplemented with development regulations to ensure that stormwater runoff is managed, and that development is protected from flooding. Enforcement of the flood damage prevention ordinance and the flood protection elevation requirement provides an extra level of protection for buildings constructed in the planning area.

Stormwater management and the requirement that post-development runoff cannot exceed pre-development conditions is one way to prevent future flood losses. Retention and detention requirements also help to reduce future flood losses.

CRS CREDIT

As of 2022, the City of Westminster has a CRS Class 6 rating, which translates to a 20% discount for Special Flood Hazard Areas (SFHA) and a 10% discount for non-SFHA. The CRS encourages strong building codes. It provides credit in two ways: points are awarded based on the community's Building Code Effectiveness Grading Schedule (BCEGS) classification and points are awarded for adopting the International Code series. The State of Colorado does not mandate the adoption of building codes by local jurisdictions; however, the City of Westminster has adopted building codes as detailed in Section 2.6.1.

CRS credits are available for regulations that encourage developers to preserve floodplains or other hazardous areas away from development. There is no credit for a plan, only for the enforceable regulations that are adopted pursuant to a plan. Communities can receive credit for Activity 430 – Higher Regulatory Standards and for Activity 420 – Open Space Preservation for preserving parcels within the SFHA as open space. Preserving flood prone areas as open space is one of the highest priorities of the Community Rating System. The credits in the 2017 manual have doubled for OSP (Open Space Preservation). The participating Communities can also receive credit for Activity 450 – Stormwater Management for enforcing regulations for stormwater management and soil and erosion control.

Property Protection

Property protection measures are used to modify buildings or property subject to damage. Property protection measures fall under three approaches:

- Modify the site to keep the hazard from reaching the building;
- Modify the building (retrofit) so it can withstand the impacts of the hazard; and
- Insure the property to provide financial relief after the damage occurs.

Property protection measures are normally implemented by the property owner, although in many cases technical and financial assistance can be provided by a government agency.

KEEPING THE HAZARD AWAY

Generally, natural hazards do not damage vacant areas. As noted earlier, the major impact of hazards is to people and improved property. In some cases, properties can be modified so the hazard does not

reach the damage-prone improvements. For example, a berm can be built to prevent floodwaters from reaching a house.

There are five common methods to keep a flood from reaching and damaging a building:

- Erect a barrier between the building and the source of the flooding.
- Move the building out of the flood-prone area.
- Elevate the building above the flood level.
- Demolish the building.
- Replace the building with a new one that is elevated above the flood level.

The latter three approaches are the most effective types to consider for the planning area.

BARRIERS

A flood protection barrier can be built of dirt or soil (a "berm") or concrete or steel (a "floodwall"). Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, the design needs to account for leaks, seepage of water underneath, and rainwater that will fall inside the perimeter. This is usually done with a sump or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier. Barriers can only be built so high. They can be overtopped by a flood higher than expected. Barriers made of earth are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and properly maintained.

RELOCATION

Moving a building out of a flood prone area to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost increases for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

BUILDING ELEVATION

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

DEMOLITION

Some buildings, especially heavily damaged or repetitively flooded ones, are not worth the expense to protect them from future damages. It is cheaper to demolish them and either replace them with new, flood protected structures, or relocate the occupants to a safer site. Demolition is also appropriate for buildings that are difficult to move – such as larger, slab foundation or masonry structures – and for dilapidated structures that are not cost-beneficial to protect.

PILOT RECONSTRUCTION

If a building is not in good shape, elevating it may not be worthwhile or it may even be dangerous. An alternative is to demolish the structure and build a new one on the site that meets or exceeds all flood protection codes. FEMA funding programs refer to this approach as "pilot reconstruction." It is still a pilot program, and not a regularly funded option. Certain rules must be followed to qualify for federal funds for pilot reconstruction.

RETROFITTING

An alternative to keeping the hazard away from a building is to modify or retrofit the site or building to minimize or prevent damage. There are a variety of techniques to do this, as described below.

- **Dry Floodproofing:** Dry floodproofing means making all areas below the flood protection level watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows, and vents, are closed, either permanently, with removable shields, or with sandbags. Dry floodproofing of new and existing nonresidential buildings in the regulatory floodplain is permitted under state, FEMA, and local regulations. Dry floodproofing of existing residential buildings in the floodplain is also permitted if the building is not substantially damaged or being substantially improved. Owners of buildings located outside the regulatory floodplain can always use dry floodproofing techniques. Dry floodproofing is only effective for shallow flooding, such as repetitive drainage problems. It does not protect from the deep flooding along rivers caused by hurricanes or other storms.
- **Wet Floodproofing:** The alternative to dry floodproofing is wet floodproofing: water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.

INSURANCE

Technically, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild, and hopefully afford to incorporate some of the other property protection measures in the process. Insurance offers the advantage of protecting the property, so long as the policy is in force, without requiring human intervention for the measure to work.

- **Private Property:** Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the NFIP. Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area. Most people purchase flood insurance because it is required by the bank when they get a mortgage or home improvement loan. Usually, these policies just cover the building's structure and not the contents. Contents coverage can be purchased separately. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building. Most people do not realize that there is a 30-day waiting period to purchase a flood insurance policy and there are limits on coverage.
- **Public Property:** Governments can purchase commercial insurance policies. Larger local governments often self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-insurance can drain the government's budget. Communities cannot expect federal disaster assistance to make up the difference after a flood.

LOCAL IMPLEMENTATION/CRS CREDIT

The CRS provides the most credit points for acquisition and relocation under Activity 520, because this measure permanently removes insurable buildings from the floodplain. Communities can receive credit for Activity 520 – Acquisition and Relocation, for acquiring and relocating buildings from the SFHA. The HMPC recommended that communities pursue the purchase of repetitive loss buildings and other buildings which are subject to flood damage to return this land to open space.

The CRS also credits barriers and elevating existing buildings under Activity 530. The credit for Activity 530 is based on the combination of flood protection techniques used and the level of flood protection provided. Points are calculated for each protected building. Bonus points are provided for the protection of repetitive loss buildings and critical facilities. Communities can receive credit for Activity 360 – Flood Protection Assistance by providing advice and assistance to homeowners who may want to flood proof their home or business. Advice is provided both on property protection techniques and on financial assistance programs to help fund mitigation.

Flood insurance information for each community is provided in Chapter 4. There is no credit for purchasing flood insurance, but the CRS does provide credit for local public information programs that, among other topics, explain flood insurance to property owners. The CRS also reduces the premiums for those people who do buy NFIP coverage. Communities can receive credit for Activity 330 – Outreach Projects.

Natural Resource Protection

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. These activities enable the naturally beneficial functions of fields, floodplains, wetlands, and other natural lands to operate more effectively. Natural and beneficial functions of watersheds, floodplains and wetlands include:

- Reduction in runoff from rainwater and stormwater in pervious areas
- Infiltration that absorbs overland flood flow
- Removal and filtering of excess nutrients, pollutants, and sediments
- Storage of floodwaters
- Absorption of flood energy and reduction in flood scour
- Water quality improvement
- Groundwater recharge
- Habitat for flora and fauna
- Recreational and aesthetic opportunities

As development occurs, many of the above benefits can be achieved through regulatory steps for protecting natural areas or natural functions. This section covers the resource protection programs and standards that can help mitigate the impact of natural hazards, while they improve the overall environment. Six areas were reviewed:

- Wetland protection
- Erosion and sedimentation control
- Stream/River restoration
- Best management practices
- Dumping regulations

EROSION AND SEDIMENTATION CONTROL

Construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along stream banks and shorelines as the volume and velocity of flow or wave action destabilize and wash away the soil. Sediment suspended in the water tends to settle out where flowing water slows down. This can clog storm drains, drain tiles, culverts, and ditches, and reduce the water transport and storage capacity of rivers, stream channels, and wetlands.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices.

STREAM/RIVER RESTORATION

There is a growing movement that has several names, such as "stream conservation," "bioengineering," or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration," which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve retrofitting the shoreline with willow cuttings, wetland plants, or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

In all, restoring the right vegetation to a stream has the following advantages:

- Reduces the amount of sediment and pollutants entering the water
- Enhances aquatic habitat by cooling water temperature
- Provides food and shelter for both aquatic and terrestrial wildlife

- Can reduce flood damage by slowing the velocity of water
- Increases the beauty of the land and its property value
- Prevents property loss due to erosion
- Provides recreational opportunities, such as hunting, fishing and bird watching
- Reduces long-term maintenance costs

Communities are required by state and federal regulations to monitor storm water drainage outfalls and control storm water runoff.

BEST MANAGEMENT PRACTICES

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the US EPA. Nonpoint source pollutants come from non-specific locations and harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, other chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining, and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches, and streams.

The term "best management practices" (BMPs) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources, and capture nonpoint source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple usages of drainage and storage facilities.

DUMPING REGULATIONS

BMPs usually address pollutants that are liquids or are suspended in water that are washed into a river or stream. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' abilities to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels. Regular inspections to catch violations should be scheduled.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard without realizing that is needed to drain street runoff. They may not understand how re-grading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

LOCAL IMPLEMENTATION/CRS CREDIT

There is credit for preserving open space in its natural condition or restored to a state approximating its natural condition. The credit is based on the percentage of the floodplain that can be documented as wetlands protected from development by ownership or local regulations. Communities can receive credit for Activity 420 – Open Space Preservation for preserving a portion of the SFHA as open space.

Additionally, credit is available for Activity 540 – Drainage System Maintenance. Having a portion of the drainage system inspected regularly throughout the year and maintenance performed as needed would earn a community credit. Communities can also get credit under this activity for providing a listing of problem sites that are inspected more frequently, and for implementing an ongoing Capital Improvements Program.

Emergency Services

Emergency services measures protect people during and after a disaster. A good emergency management program addresses all hazards, and it involves all local government departments. This section reviews emergency services measures following a chronological order of responding to an emergency. It starts with identifying an impending problem (threat recognition) and continues through post-disaster activities.

THREAT RECOGNITION

The first step in responding to a flood is to know when weather conditions are such that an event could occur. With a proper and timely threat recognition system, adequate warnings can be disseminated.

The National Weather Service (NWS) is the prime agency for detecting meteorological threats. Severe weather warnings are transmitted through NOAA's Weather Radio System. Local emergency managers can then provide more site-specific and timely recognition after the Weather Service issues a watch or a warning. A flood threat recognition system predicts the time and height of a flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

On smaller rivers and streams, locally established rainfall and river gauges are needed to establish a flood threat recognition system. The NWS may issue a "flash flood watch." This is issued to indicate current or developing hydrologic conditions that are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain nor imminent. These events are so localized and so rapid that a "flash flood warning" may not be issued, especially if no remote threat recognition equipment is available. In the absence of a gauging system on small streams, the best threat recognition system is to have local personnel monitor rainfall and stream conditions. While specific flood crests and times will not be predicted, this approach will provide advance notice of potential local or flash flooding.

WARNING

The next step in emergency response following threat recognition is to notify the public and staff of other agencies and critical facilities. More people can implement protection measures if warnings are early and include specific detail.

The NWS issues notices to the public using two levels of notification:

- Watch: conditions are right for flooding, thunderstorms, tornadoes, or winter storms.
- Warning: a flood, tornado, etc., has started or been observed.

A more specific warning may be disseminated by the community in a variety of ways. The following are the more common methods:

- CodeRED mass telephone emergency communication system
- Commercial or public radio or TV stations
- The Weather Channel
- Cable TV emergency news inserts
- Telephone trees/mass telephone notification
- NOAA Weather Radio
- Tone activated receivers in key facilities
- Outdoor warning sirens
- Sirens on public safety vehicles
- Door-to-door contact
- Mobile public address systems
- Email notifications

Just as important as issuing a warning is telling people what to do in case of an emergency. A warning program should include a public information component.

STORMREADY

The National Weather Service (NWS) established the StormReady program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather conditions locally
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises

Being designated an NWS StormReady community is a good measure of a community's emergency warning program for weather hazards.

RESPONSE

The protection of life and property is the most important task of emergency responders. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations center (emergency preparedness)
- Closing streets or bridges (police or public works)
- Shutting off power to threatened areas (utility company)
- Passing out sand and sandbags (public works)
- Holding children at school or releasing children from school (school superintendent)
- Opening evacuation shelters (the American Red Cross)
- Monitoring water levels (public works)
- Establishing security and other protection measures (police)

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and of changing conditions. The result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner possible.

EVACUATION AND SHELTER

There are six key components to a successful evacuation:

- Adequate warning
- Adequate routes
- Proper timing to ensure the routes are clear
- Traffic control
- Knowledgeable travelers
- Care for special populations (e.g., disabled persons, prisoners, hospital patients, schoolchildren)

Those who cannot get out of harm's way need shelter. Typically, the American Red Cross will staff a shelter and ensure that there is adequate food, bedding, and wash facilities. Shelter management is a specialized skill. Managers must deal with problems like scared children, families that want to bring in their pets, and the potential for an overcrowded facility.

LOCAL IMPLEMENTATION/CRS CREDIT

Flash flood warnings are issued by National Weather Service Offices, which have local warning responsibility. Flood warnings are forecasts of coming floods, are distributed to the public by the NOAA Weather Radio, commercial radio, and television, and through local emergency agencies. The warning message tells the expected degree of flooding, the affected river, when and where flooding will begin, and the expected maximum river level at specific forecast points during flood crest.

Communities can receive credit for Activity 610 – Flood Warning Program for maintaining a program that provides timely identification of impending flood threats, disseminates warnings to appropriate floodplain residents, and coordinates flood response activities. Community Rating System credits are based on the number and types of warning media that can reach the community's flood prone population. Depending on the location, communities can receive credit for the telephone calling system and more credits for additional measures, like telephone trees. Being designated as a StormReady community also provides additional credits.

Structural Projects

Four general types of flood control projects are reviewed here: levees, reservoirs, diversions, and dredging. These projects have three advantages not provided by other mitigation measures:

- They can stop most flooding, protecting streets and landscaping in addition to buildings.
- Many projects can be built without disrupting citizens' homes and businesses.
- They are constructed and maintained by a government agency, a more dependable long-term management arrangement than depending on many individual private property owners.

However, as shown below, structural measures also have shortcomings. The appropriateness of using flood control depends on individual project area circumstances.

- Advantages
 - They may provide the greatest amount of protection for land area used
 - Because of land limitations, they may be the only practical solution in some circumstances
 - They can incorporate other benefits into structural project design, such as water supply and recreational uses
 - Regional detention may be more cost-efficient and effective than requiring numerous small detention basins
- Disadvantages
 - They can disturb the land and disrupt the natural water flows, often destroying wildlife habitat
 - They require regular maintenance
 - They are built to a certain flood protection level that can be exceeded by larger floods
 - They can create a false sense of security
 - They promote more intensive land use and development in the floodplain

LEVEES AND FLOODWALLS

Probably the best-known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

RESERVOIRS AND DETENTION

Reservoirs reduce flooding by temporarily storing flood waters behind dams or in storage or detention basins. Reservoirs lower flood heights by holding back, or detaining, runoff before it can flow downstream. Flood waters are detained until the flood has subsided, and then the water in the reservoir or detention basin is released or pumped out slowly at a rate that the river can accommodate downstream.

Flood control reservoirs are most commonly built for one of two purposes. Large reservoirs are constructed to protect property from existing flood problems. Smaller reservoirs, or detention basins, are built to protect property from the stormwater runoff impacts of new development.

DIVERSION

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During floods, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving stream or river.

LOCAL IMPLEMENTATION /CRS CREDIT

Structural flood control projects that provide at least 100-year flood protection and that result in revisions to the Flood Insurance Rate Map are not credited by the CRS so as not to duplicate the larger premium reduction provided by removing properties from the mapped floodplain. Other flood control projects can be accepted by offering a 25-year flood protection.

Public Information and Outreach

OUTREACH PROJECTS

Outreach projects are the first step in the process of orienting property owners to the hazards they face and to the concept of property protection. They are designed to encourage people to seek out more information to take steps to protect themselves and their properties.

Awareness of the hazard is not enough; people need to be told what they can do about the hazard. Thus, projects should include information on safety, health, and property protection measures. Research has shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Community newsletters/direct mailings: The most effective types of outreach projects are mailed or distributed to everyone in the community. In the case of floods, they can be sent only to floodplain property owners.

News media: Local newspapers can be strong allies in efforts to inform the public. Local radio stations and cable TV channels can also help. These media offer interview formats and cable TV may be willing to broadcast videos on the hazards.

LIBRARIES AND WEBSITES

The two previous activities tell people that they are exposed to a hazard. The next step is to provide information to those who want to know more. The community library and local websites are obvious places for residents to seek information on hazards, hazard protection, and protecting natural resources.

Books and pamphlets on hazard mitigation can be given to libraries, and many of these can be obtained for free from state and federal agencies. Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government. Today, websites are commonly used as research tools. They provide fast access to a wealth of public and private sites for information. Through links to other websites, there is almost no limit to the amount of up-to-date information that can be accessed on the Internet.

In addition to online floodplain maps, websites can link to information for homeowners on how to retrofit for floods or a website about floods for children.

TECHNICAL ASSISTANCE

HAZARD INFORMATION

Residents and business owners that are aware of the potential hazards can take steps to avoid problems or reduce their exposure to flooding. Communities can easily provide map information from FEMA's FIRMs and Flood Insurance Studies. They may also assist residents in submitting requests for map

amendments and revisions when they are needed to show that a building is located outside the mapped floodplain.

Some communities supplement what is shown on the FIRM with information on additional hazards, flooding outside mapped areas and zoning. When the map information is provided, community staff can explain insurance, property protection measures and mitigation options that are available to property owners. They should also remind inquirers that being outside the mapped floodplain is no guarantee that a property will never flood.

PROPERTY PROTECTION ASSISTANCE

While general information provided by outreach projects or the library is beneficial, most property owners do not feel ready to retrofit their buildings without more specific guidance. Local building department staffs are experts in construction. They can provide free advice, not necessarily to design a protection measure, but to steer the owner onto the right track. Building or public works department staffs can provide the following types of assistance:

- Visit properties and offer protection suggestions
- Recommend or identify qualified or licensed contractors
- Inspect homes for anchoring of roofing and the home to the foundation
- Explain when building permits are needed for home improvements.

PUBLIC INFORMATION PROGRAM

A Program for Public Information (PPI) is a document that receives CRS credit. It is a review of local conditions, local public information needs, and a recommended plan of activities. A PPI consists of the following parts, which are incorporated into this plan:

- The local flood hazard
- The property protection measures appropriate for the flood hazard
- Flood safety measures appropriate for the local situation
- The public information activities currently being implemented within the community, including those being carried out by non-government agencies
- Goals for the community's public information program
- The outreach projects that will be done each year to reach the goals
- The process that will be followed to monitor and evaluate the projects

LOCAL IMPLEMENTATION /CRS CREDIT

Communities can receive credit under Activity 330 – Outreach Projects as well as Activity 350 – Flood Protection Information. Credit is available for targeted and general outreach projects. Credit is also provided for making publications relating to floodplain management available in the reference section of the local library.

D.3 Mitigation Alternative Selection Criteria

The following criteria were used to select and prioritize proposed mitigation measures:

STAPLE/E

- **Social** – Does the measure treat people fairly? (different groups, different generations)
- **Technical** – Will it work? (Does it solve the problem? Is it feasible?)
- **Administrative** – Do you have the capacity to implement and manage project?
- **Political** – Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support?

- **Legal** – Does your organization have the authority to implement? Is it legal? Are there liability implications?
- **Economic** – Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
- **Environmental** – Does it comply with environmental regulations?

Other

- Does the proposed action protect lives?
- Does the proposed action address hazards or areas with the highest risk?
- Does the proposed action protect critical facilities, infrastructure, or community assets?
- Does the proposed action meet multiple objectives (multi-objective management)?

APPENDIX D MITIGATION CATEGORIES, ALTERNATIVES, AND SELECTION CRITERIA

Table D.1 Example Mitigation Actions Items by Category and Hazard

Alternative Mitigation Actions	Human Health hazards (Pan flu, West Nile)	Dam Failure	Floods	Soil Hazards (erosion, deposition, and expansive soils)	Severe Weather (hail, lightning, wind, temps, fog, drought)	Tornadoes and Earthquake	Wildfire/ Grassland Fire	Winter Weather
PREVENTION								
Building codes and enforcement			■	■	■	■	■	■
Comprehensive Watershed Tax			■					
Density controls		■	■	■			■	
Design review standards			■	■		■	■	
Easements			■	■			■	
Environmental review standards			■	■		■	■	
Floodplain development regulations		■	■					
Hazard mapping		■	■	■			■	
Floodplain zoning		■	■					
Forest fire fuel reduction							■	
Housing/landlord codes					■			
Slide-prone area/grading/hillside development regulations				■			■	
Manufactured home guidelines/regulations		■	■		■	■		
Multi-Jurisdiction Cooperation within watershed		■	■					
Open space preservation		■	■	■			■	
Performance standards		■	■	■	■	■	■	■
Special use permits		■	■	■			■	
Stormwater management regulations			■					
Subdivision and development regulations		■	■	■		■	■	
Surge protectors and lightning protection					■			

APPENDIX D MITIGATION CATEGORIES, ALTERNATIVES, AND SELECTION CRITERIA

Alternative Mitigation Actions	Human Health hazards (Pan flu, West Nile)	Dam Failure	Floods	Soil Hazards (erosion, deposition, and expansive soils)	Severe Weather (hail, lightning, wind, temps, fog, drought)	Tornadoes and Earthquake	Wildfire/ Grassland Fire	Winter Weather
Tree Management					■		■	■
Transfer of development rights			■	■			■	
Utility location				■	■			■
PROPERTY PROTECTION								
Acquisition of hazard prone structures		■	■	■			■	
Construction of barriers around structures		■	■					
Elevation of structures		■	■					
Relocation out of hazard areas		■	■	■			■	
Non structural improvements (safety film on windows, bookshelf anchoring, critical equipment bracing etc.)					■	■		
Structural retrofits (e.g., reinforcement, floodproofing, bracing, etc.)			■		■	■	■	■
PUBLIC EDUCATION AND AWARENESS								
Debris Control			■					
Flood Insurance		■	■					
Hazard information centers	■	■	■	■	■	■	■	■
Public education and outreach programs	■	■	■	■	■	■	■	■
Real estate disclosure		■	■	■	■	■	■	■
Crop Insurance					■	■		
NATURAL RESOURCE PROTECTION								
Best Management Practices (BMPs)	■		■	■	■		■	
Forest and vegetation management	■	■	■	■	■		■	■
Hydrological Monitoring	■	■	■	■	■			

APPENDIX D MITIGATION CATEGORIES, ALTERNATIVES, AND SELECTION CRITERIA

Alternative Mitigation Actions	Human Health hazards (Pan flu, West Nile)	Dam Failure	Floods	Soil Hazards (erosion, deposition, and expansive soils)	Severe Weather (hail, lightning, wind, temps, fog, drought)	Tornadoes and Earthquake	Wildfire/ Grassland Fire	Winter Weather
Sediment and erosion control regulations		■	■	■				
Stream corridor restoration			■	■				
Stream dumping regulations			■					
Urban forestry and landscape management		■	■	■	■		■	■
Wetlands development regulations			■	■			■	
EMERGENCY SERVICES								
Critical facilities protection		■	■	■	■	■	■	■
Emergency response services		■	■	■	■	■	■	■
Hazard threat recognition	■	■	■	■	■	■	■	■
Hazard warning systems (community sirens, NOAA weather radio)		■	■	■	■	■	■	■
Health and safety maintenance	■	■	■	■	■	■	■	■
Evacuation planning	■	■	■	■			■	
STRUCTURAL PROJECTS								
Channel maintenance			■					
Dams/reservoirs (including maintenance)		■	■					
Levees and floodwalls (including maintenance)			■					
Safe room/shelter					■	■		■
Snow fences								■
Water supply augmentation					■			
Post-disaster mitigation	■	■	■	■	■	■	■	■