City of Thornton

Federal Heights

Northglenn

Thornton, Federal Heights, Northglenn Hazard Mitigation Plan



Assistance provided by:

wood.

April 2023

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City Officials

City of Thornton

Mayor:	Jan Kulmann	
City Manager:	Kevin Woods	
City Council:	David Acunto	Julia Marvin
	Karen Bigelow	Adam Matkowsky
	Eric Garcia	Jessica Sandgren
	Kathy Henson	Tony Unrein

City of Federal Heights

Mayor:	Linda S. Montoya	
City Manager:	Jacqueline Halburnt	
City Council:	Celeste Arner	Doris Peterson
	Sonia Jensen	Bonnie Sellers
	Sarah Dawn Pearlstein	Elaine Sweeney

City of Northglenn

Mayor:	Meredith Leighty	
City Manager:	Heather Geyer	
City Council:	Becky Brown	Shannon Lukeman-Hiromasa
	Katherine E. Goff	Nicholas Walker
	Jay Jaramillo	Jenny Willford
	Richard Kondo	Ashley Witkovich

1 Introduction

1.1 Executive Summary

Hazard mitigation is the use of long- and short-term strategies to reduce or alleviate loss of life, injuries, and property damage that can result from a disaster. Studies have found that hazard mitigation is extremely cost-effective, with every dollar spent on mitigation saving an average of $6 in avoided future losses.

The Cities of Thornton, Federal Heights, and Northglenn have jointly developed this Hazard Mitigation Plan to serve as a blueprint for coordinating and implementing hazard mitigation policies, programs, and projects in the Cities. It provides a list of mitigation goals and related actions to assist the Cities in reducing risk and preventing loss from future hazard events. The impacts of hazards can often be lessened, or even avoided, if appropriate actions are taken before events occur. By reducing exposure to known hazard risks, the Cities will save lives and property and minimize the social, economic, and environmental disruptions that commonly follow hazard events.

This Plan was also developed to maintain the Cities' eligibility for federal mitigation funds, specifically the Federal Emergency Management Agency's (FEMA), Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), and Building Resilient Infrastructure and Communities (BRIC) grant program. The FEMA requires that hazard mitigation plans be updated every five years for the jurisdiction to be eligible for federal mitigation assistance.

The 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan (HMP) is a full update of the 2017 Thornton, Federal Heights, and Northglenn HMP. All sections of the 2017 Plan were reviewed and updated to address natural hazards for the purpose of saving lives and reducing losses from future disasters or hazard events.

Section 1 Introduction contains this Executive Summary, and outlines the background, purpose, and scope of the Plan.

Section 2 Planning Process describes the process followed to update the Plan. A broad range of public and private stakeholders, including agencies, local businesses, nonprofits, and other interested parties, were invited to participate. Public input was sought throughout the planning process including online surveys and public review of the draft plan.

Section 3 Community Profile describes the planning area, consisting of the Cities of Thornton, Federal Heights, and Northglenn, including growth areas and properties owned by the Cities in neighboring counties. It includes updated information on demographics, social vulnerability, and changes in development. It includes an assessment of programs and policies currently in place to reduce hazard impacts or that could be used to implement hazard mitigation activities and identifies opportunities to enhance those capabilities.

Section 4 Hazard Identification and Risk Assessment identifies the natural and technological hazards of greatest concern to the Cities and describes the risk from those hazards. The information gathered through the risk assessment helps to prioritize and focus efforts on those hazards of greatest concern and those assets or areas facing the greatest risk(s). The best available information on the impacts of changing weather conditions were taken into account for each hazard. The hazards profiled in this 2023 Plan update and their assessed significance are shown in the following table.

Table 1-1 Hazards Summary

Hazard	Federal Heights	Northglenn	Thornton
Cyber Attack	Medium	Medium	Medium
Dam Failure	Low	Low	Medium
Drought & Excessive Heat	Medium	Medium	Medium
Earthquake	Low	Low	Low
Expansive Soils	Low	Low	Medium
Flood	High	High	High
Ground & Surface Water Supply Contamination	Medium	Medium	Medium
Hazardous Materials	Medium	Medium	Medium
Mass Transportation Incident	Medium	Medium	Medium
Public Health Hazards	High	High	High
Severe Cold Weather Storms	High	High	High
Severe Warm Weather Storms	Medium	Medium	Medium
Terrorism & Active Shooters	Medium	Medium	Medium
Tornadoes & Microbursts	Medium	Medium	Medium
Wildland Fire	Low	Medium	Medium

Section 5 Mitigation Strategy describes the actions the Cities will take to reduce vulnerability to the hazards identified in Section 4. It presents the goals and objectives of the mitigation program and details a broad range of targeted mitigation actions to reduce losses from hazard events.

Section 6 Plan Implementation and Maintenance details how the Plan will be implemented, monitored, evaluated, and updated as well as how the mitigation program will be integrated into other planning mechanisms.

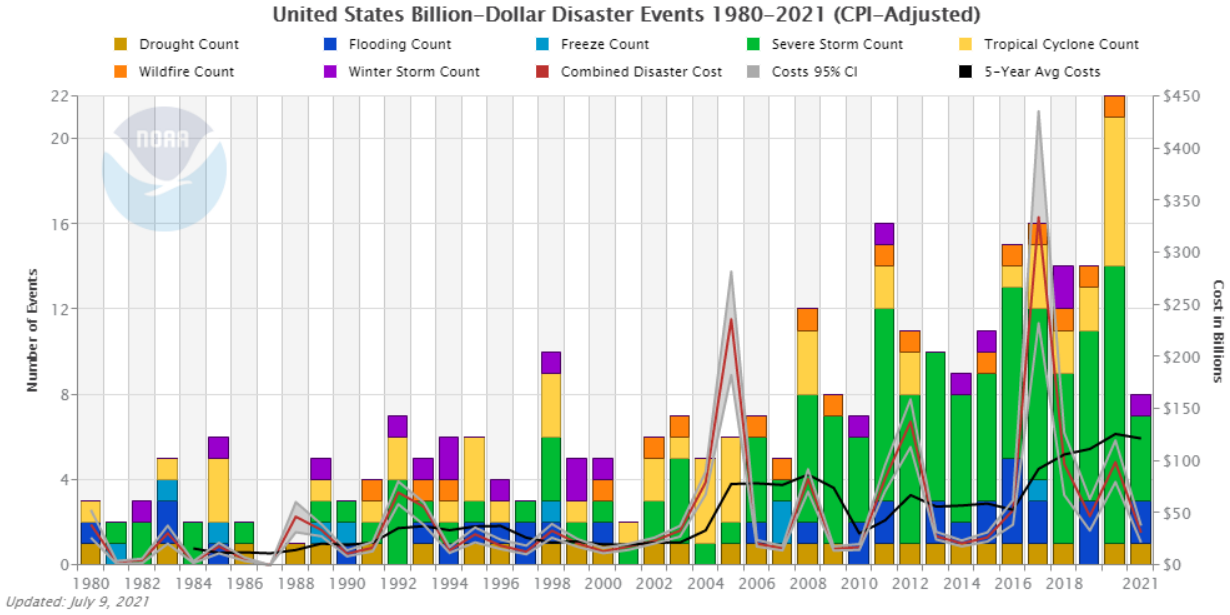
Three **City Annexes** supplement the base plan by providing additional information specific to each of the participating Cities, including larger-scale maps.

It is important that local decision makers stay involved in mitigation planning to provide new ideas and insight for future updates to this HMP. As a long-term goal, the HMP and the mitigation strategies identified within should be fully integrated into daily decisions and routines of the Cities' governments. This will continue to require dedication and hard work, and to this end, this Plan update continues efforts to further strengthen the Cities' resiliency.

1.2 Background

While some communities are less hazard-prone than others, there are no hazard-free communities, and all communities face some degree of risk from natural and human-caused disasters. Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. In 2020, the FEMA declared over 300 disasters and emergencies due to natural hazards, including floods, wildfires, earthquakes, and a pandemic. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. Additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars, making the costs of disasters several times higher than calculated amounts. Disasters can also weaken local economies and dramatically reduce local tax bases. In 2020, there were 22 events that caused more than $1 billion in disaster losses, breaking the previous record of 16 events in a single year. Figure 1-1 shows the number and type of natural disasters in the U.S. that have caused more than one billion dollars in damage since 1980, showing how the frequency and cost of major disasters have risen over the past several decades.

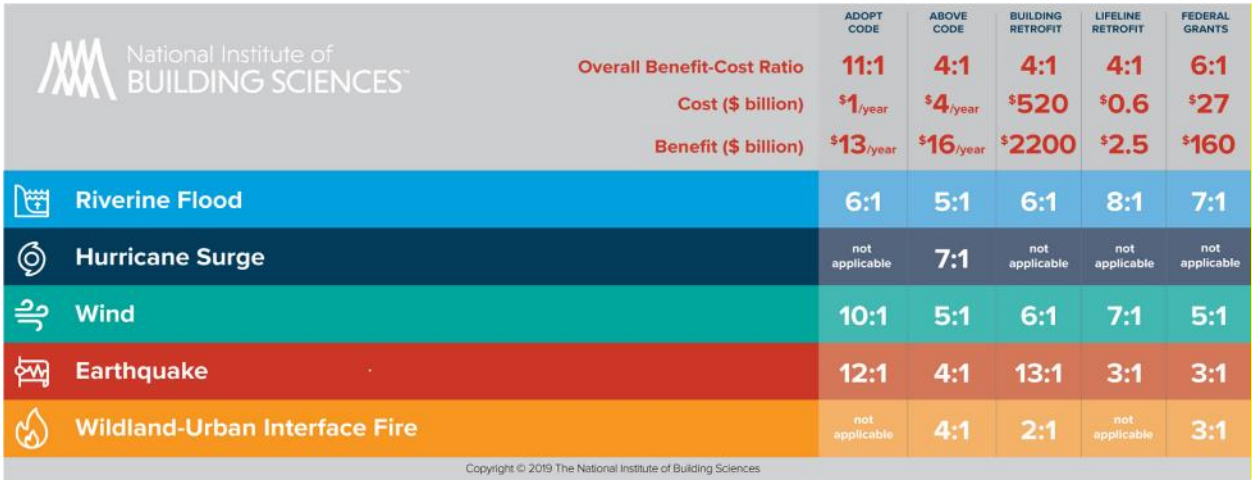
Figure 1-1 Billion-Dollar Disasters in the U.S., 1980-2021



Source: NOAA

The rising cost of disasters has sharpened interest in identifying effective ways to reduce vulnerability to hazards. Many disasters are predictable, and much of the damage caused by these events can be mitigated through the use of various zoning, construction, and permitting vehicles and other preventative actions. Hazard mitigation planning is the process through which 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. 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 $6 in avoided future losses in addition to saving lives and preventing injuries, as illustrated in Figure 1-2.

Figure 1-2 Financial Benefits of Hazard Mitigation



Source: National Institute of Building Sciences, Natural Hazard Mitigation Saves: 2019 Report

HMPs assist communities in reducing risk from hazards by identifying resources, information, and strategies for risk reduction. This plan documents the hazard mitigation planning process, identifies relevant hazards and risks, and outlines the actions that will be taken to decrease vulnerability and increase resilience and sustainability.

This plan was prepared 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) and finalized on October 31, 2007. These regulations established the requirements that local HMPs must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the Cities of Thornton, Federal Heights, and Northglenn are subject to many kinds of hazards, access to these programs is vital.

This plan was originally prepared in 2017 and has been comprehensively updated in 2023. 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 community by protecting critical community facilities and minimizing overall community impacts and disruption.

1.3 Purpose & Scope

The purpose of this plan is to provide the Cities of Thornton, Federal Heights, and Northglenn with a comprehensive hazard mitigation strategy for reducing long-term risks to people, property, and natural resources.

This HMP identifies resources, information, and strategies for reducing risk from technological and natural hazards. Elements and strategies in the plan were selected because they best meet the needs of the planning partners and the people of the three Cities. This plan will help guide and coordinate mitigation activities throughout the Cities.

All citizens and businesses of the Cities are the ultimate beneficiaries of this HMP update. The plan reduces risk for those who live in, work in, and visit the Cities. It provides a viable planning framework for all foreseeable natural hazards that may impact the Cities. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable throughout the Cities, and the plan's goals and recommendations

can lay groundwork for the development and implementation of local mitigation activities and partnerships.

The Cities of Thornton, Federal Heights, and Northglenn remain dedicated to implementing the actions and strategies outlined in this updated Hazard Mitigation Plan. This Plan will be maintained regularly to address changes in hazards or vulnerabilities, track progress in implementation, and will be updated within the next five years.

2 Planning Process

DMA 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:

An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

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 non-profit interests to be involved in the planning process; and

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.

2.1 Background on Mitigation Planning in the Cities of Thornton, Federal Heights, and Northglenn

The Cities of Thornton and Federal Heights were previously included in a Regional Natural Hazard Mitigation Plan created by the Denver Regional Council of Governments (DRCOG) in 2010. In 2017, the Cities of Thornton, Federal Heights, and Northglenn joined together to create the first version of this Plan. This plan underwent a comprehensive update in 2021-2023 to comply with the five-year update cycle required by the DMA 2000. This update planning process was initiated in 2021 under the coordination of the City Emergency Managers. This updated HMP complies with Federal Emergency Management Agency (FEMA) guidance for Local Hazard Mitigation Plans, the requirements in the Disaster Mitigation Act (DMA) of 2000, and FEMA's 2013 Local Hazard Mitigation Planning Handbook.

2.1.1 What's New in the 2023 Plan

This HMP update involved a comprehensive review and update of each section of the 2017 plan, including an assessment of the progress of evaluating, monitoring, and implementing the mitigation strategy outlined in the previous plan. The planning process provided an opportunity to review priorities related to hazard significance and mitigation actions, and revisions were made to the plan where applicable. Information and data still valid from the 2017 plan were carried forward to this HMP update where appropriate. In addition to the natural hazards addressed in the 2017 Plan, several human-caused hazards were added to the 2023 update.

The Hazard Mitigation Planning Committee (HMPC) updated each section of the previously approved plan to include new information and improve the organization and formatting of the plan's contents. The HMPC analyzed each section using FEMA's local plan update guidance to ensure that the plan met the latest requirements. Upon review the HMPC determined that nearly every section of the plan would need some updates. The Risk Assessment in Section 4 was revised to incorporate recent events and reflect recent development trends with an updated GIS-based risk assessment, as well as the addition of several human-caused hazards. Information within has been updated throughout the plan where appropriate. The Mitigation Strategy in Section 5 has been updated to reflect current priorities and mitigation actions moving forward from the 2017 plan.

2.1.2 Local Government Participation

The 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan is a multi-jurisdictional plan that geographically covers everything within the Cities of Thornton, Federal Heights, and Northglenn. It also includes designated growth areas around the cities, as well as properties owned by Thornton in neighboring counties. All three cities participated fully in the 2023 planning process.

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 as part of the HMPC,
- Detail areas within the planning area where the risk differs from that facing the entire area,
- Identify specific projects to be eligible for funding, and
- Have the governing board formally adopt the plan.

For the 2023 HMP update process, participation was defined as:

- Attending and participating in the HMPC meetings,
- Providing available data requested of the HMPC,
- Reviewing and providing comments on the plan drafts,
- Advertising, coordinating, and participating in the public input process, and
- Coordinating the formal adoption of the plan by the governing boards.

2.2 2023 Planning Process

A consultant, Wood Environment and Infrastructure Solutions, Inc. (Wood), was contracted to assist with the update. The Cities of Thornton, Federal Heights, and Northglenn collaborated with Wood to establish the planning process for the plan update using the DMA planning requirements and FEMA's associated guidance. The original FEMA planning guidance is structured around a four-phase process:

1. Organize Resources
2. Assess Risks
3. Develop the Mitigation Plan
4. 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, Wood integrated a more detailed 10-step planning process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the modified 10-step process used for this plan meets the funding eligibility requirements of the Hazard Mitigation Assistance grants (including the Hazard Mitigation Grant Program, the Building Resilient Infrastructure and Communities grant, and the Flood Mitigation Assistance grant), the High Hazard Potential Dams grant, the Community Rating System, and the flood control projects authorized by the U.S. Army Corps of Engineers (USACE). Table 2-1 summarizes the four-phase DMA process, the detailed CRS planning steps and work plan used to develop the plan and the nine handbook planning tasks from FEMA's 2013 Local Mitigation Planning Handbook. The sections that follow describe each planning step in more detail.

Table 2-1 Mitigation Planning Process Used to Update the Plan

FEMA's 4-Phase DMA Process	Modified 10-Step CRS Process	FEMA Local Mitigation Planning Handbook Tasks
1) Organize Resources		
201.6(c)(1)	1) Organize the Planning Effort	1: Determine the planning area and resources
201.6(b)(1)	2) Involve the Public	2: Build the planning team - 44 CFR 201.6 (C)(1)
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies	3: Create an outreach strategy - 44 CFR 201.6(b)(1)
		4: Review community capabilities - 44 CFR 201.6 (b)(2)&(3)
2) Assess Risks		
201.6(c)(2)(i)	4) Identify the Hazards	5: Conduct a risk assessment - 44 CFR 201.6 (C)(2)(i) 44 CFR 201.6(C)(2)(ii)&(iii)
201.6(c)(2)(ii)	5) Assess the Risks	
3) Develop the Mitigation Plan		
201.6(c)(3)(i)	6) Set Goals	6: Develop a mitigation strategy - 44 CFR 201.6(c)(3)(i); 44 CFR 201(c)(3)(ii) and 44 CFR 201.6(c)(3)(iii)
201.6(c)(3)(ii)	7) Review Possible Activities	
201.6(c)(3)(iii)	8) Draft an Action Plan	
4) Implement the Plan and Monitor Progress		
201.6(c)(5)	9) Adopt the Plan	7: Review and adopt the plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan	8: Keep the plan current
		9: Create a safe and resilient community - 44 CFR 201.6(c)(4)

Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

This section describes the planning process used during the 2023 update. The City's Emergency Managers took the lead on coordinating and reconvening the HMPC, identifying the key local government and initial stakeholder representatives. An email invitation was sent to those agencies requesting their participation in the HMPC and attendance at the kickoff meeting. Representatives from a wide range of city departments and stakeholders participated on the HMPC and assisted with the plan update. This included local and regional agencies involved in hazard mitigation activities, agencies that regulate development, and neighboring communities. Other local, state, federal, and private stakeholders invited to participate in the HMPC are discussed under Planning Step 3. A list of HMPC representatives and participating stakeholders can be found in Appendix B.

During the plan update process, the HMPC communicated via a combination of virtual meetings, phone interviews, and email correspondence. Three planning meetings with the HMPC were held during the plan's development between October 2021 and March 2022. The meeting schedule and topics are listed in the following table. The meetings were held virtually due to the global COVID-19 pandemic that required social distancing. Agendas, attendance rosters, and meeting summaries for each of the meetings are included in Appendix C.

Table 2-2 Schedule of Meetings

HMPC Meeting	Meeting Topic	Meeting Date
1	Kickoff Meeting: Introduction to DMA Planning and overview of Update Process	October 21, 2021

HMPC Meeting	Meeting Topic	Meeting Date
2	Risk Assessment Summary/Goals Development	December 8, 2021
3	Mitigation Strategy Development	March 3, 2022

HMPC Meeting #1 – Kickoff Webinar

During the kickoff webinar on October 21, 2021, Wood presented information on the scope and purpose of the plan update, participation requirements of HMPC, and the proposed project work schedule. Thirty-eight participants attended the kickoff meeting. Plans for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. Wood also introduced the hazard identification requirements and data. The HMPC discussed past events and impacts and future probability for each of the hazards required by FEMA for consideration in a local hazard mitigation plan. Each jurisdiction provided updates through a data collection workbook created by Wood and mitigation action trackers or provided information directly to Wood for incorporation into the plan update

HMPC Meeting #2 – Risk Assessment Update

On December 8, 2021, the HMPC convened virtually to review and discuss the results of the risk and vulnerability assessment update. Thirty-two members of the HMPC and stakeholders were present for the discussion. Wood presented preliminary risk assessment results for natural and human-caused hazards. The group went through each hazard together and discussed the results as well as shared any local insight to inform the HIRA update. A survey was shared with the HMPC after the meeting that asked the members to rank each hazard that should be included in the plan update. The survey also asked the HMPC to review the 2017 mitigation goals and determine if they were still valid, comprehensive, and reflect current priorities and updated risk assessments. Refer to the meeting summary in Appendix C for notes related to each hazard discussed and results from the post meeting survey.

HMPC Meeting #3 – Mitigation Strategy

The HMPC convened virtually on March 3, 2022, with twenty-nine people participating to discuss updates to the mitigation action plan from 2017 and finalize the goals and objectives for this planning process. The group reviewed the public survey results and noted the differences between the HMPC's hazard ratings and the public's perception of risks to the various hazards. The group discussed the criteria for mitigation action selection and prioritization using a worksheet provided by Wood (see Appendix C). The meeting ended with a review of the next steps and planning process schedule. Wood provided the HMPC with a link to an online form to submit new mitigation actions. During the HMPC review of the full plan, each member was provided a handout on prioritizing new mitigation actions and asked to focus on prioritizing each new mitigation action proposed.

Planning Step 2: Involve the Public

At the kickoff meeting, the HMPC discussed options for soliciting public input on the mitigation plan and developed an outreach strategy by consensus. The fact that the process was conducted during the COVID-19 pandemic, with attendant restrictions on public gatherings, made it difficult to use many traditional outreach methods such as in-person public gatherings or discussion at other forums. The HMPC adapted by leveraging virtual meetings and other online messaging, which in many cases resulted in greater public attendance and involvement than more traditional face-to-face meetings. The cities in the planning area developed and advertised a public survey through social media platforms, such as Facebook and Twitter. Examples of some of the announcements are shown in Figure 2-1 and Figure 2-2.

Figure 2-1 City of Northglenn Hazard Mitigation Plan Update Public Outreach



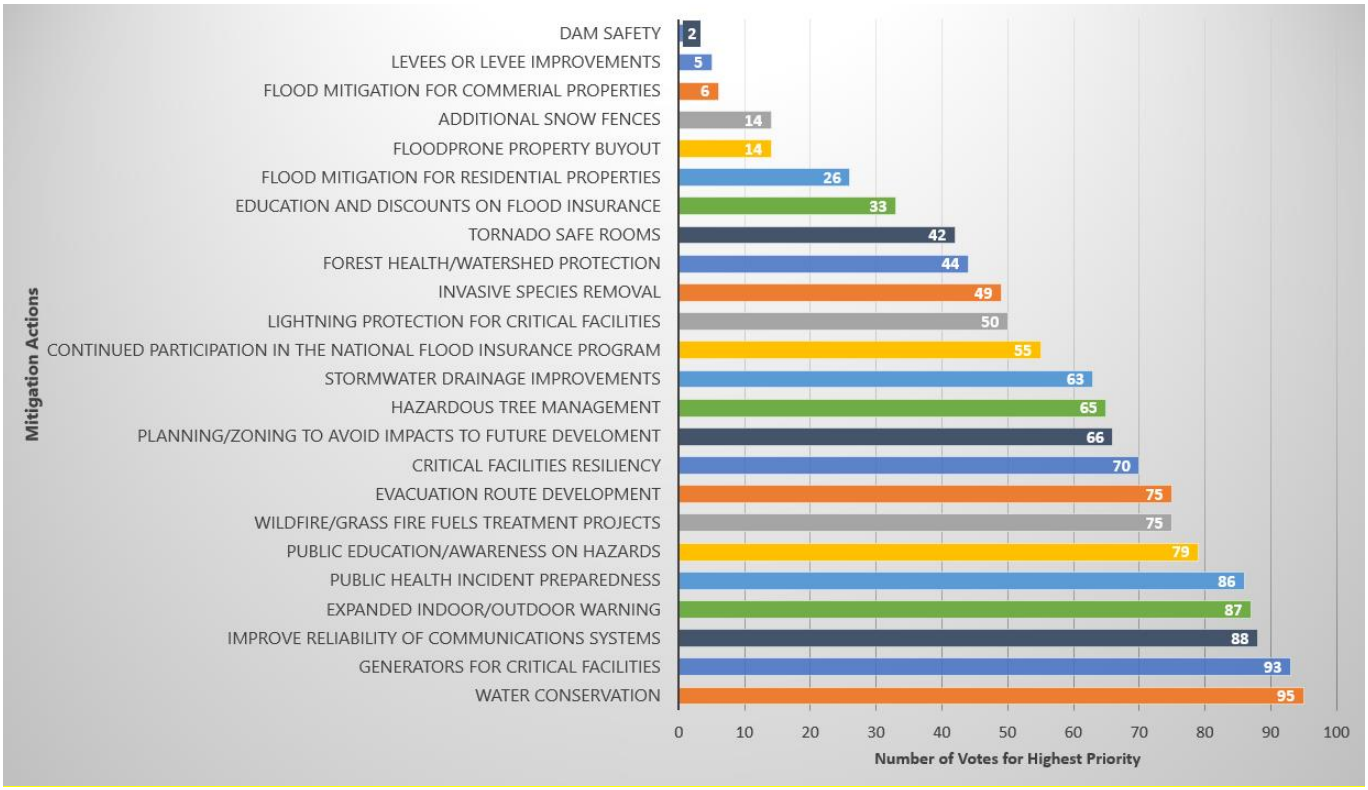
Figure 2-2 City of Thornton Hazard Mitigation Plan Update Public Outreach



The survey provided an opportunity for public input during the planning process, prior to finalization of the plan update. The public survey received responses from 155 individuals. Responses indicate that the public perceives the most significant hazards to be drought, winter storm, and severe storms. The Planning Team considered the public's rankings when assessing the significance of each hazard.

Figure 2-3 below displays the results from Question 7, which asked respondents what types of mitigation actions should have the highest priority in the updated mitigation strategy. The results show that water conservation was the most prioritized mitigation action by the public, followed by generators for critical facilities and improve reliability of communications systems. These results were considered during the planning process and in the development of new mitigation actions, to include: TH57, TH58, FH9, FH11, and NG4. Complete results of the public survey are provided in Appendix D.

Figure 2-3 Public Survey Results, Question 7



The public was also given an opportunity to review and comment on the draft plan August 1-14, 2022. The comment period was advertised through the Cities' websites and social media accounts. The draft plan and supplemental information were made available through a virtual public meeting space, along with a public comment form. In total one comment was submitted. The Planning Team reviewed the comment and revised the Flood section to reflect those comments. Public comments are included in Appendix D; record of public advertisements can be found in Appendix C.

Planning Step 3: Coordinate with Other Departments and Agencies

There are numerous organizations whose goals and interests interface with hazard mitigation in the Cities of Thornton, Federal Heights, and Northglenn. Coordination with these organizations and other community planning efforts is vital to the success of this plan update. The HMPC invited (by email) other local, state, and federal agencies to the kickoff meeting to learn about and participate in the hazard mitigation planning initiative. Many of the agencies participated throughout the planning process in meetings described in Step 1: Organize the Planning Effort. In addition, the HMPC developed a list of neighboring communities and local and regional agencies involved in hazard mitigation activities, as well as other interested parties to keep informed on the plan update process.

Stakeholders included local and regional agencies involved in hazard mitigation activities or those beyond the city and local government that have the authority to regulate development. Stakeholders could participate in various ways, either by contributing input at HMPC meetings, being aware of planning activities through an email group, providing information to support the effort, or reviewing and commenting on the draft plan. Representatives from the following agencies and organizations were invited to participate as stakeholders in the process; an asterisk indicates they attended HMPC meetings.

State and Federal Agencies

- Colorado Division of Homeland Security and Emergency Management*
- Colorado Division of Water Resources - Dam Safety Branch
- Colorado State Forest Service
- Colorado Department of Transportation
- Colorado State Patrol
- Colorado Geological Survey
- Colorado Parks and Wildlife
- Colorado Water Conservation Board
- United States Forest Service
- United States Geological Survey
- FEMA Region VIII
- United States Environmental Protection Agency
- National Weather Service

Neighboring Jurisdictions

- Adams County
- Larimer County
- Weld County
- City & County of Denver
- City & County of Broomfield
- City of Commerce City
- City of Westminster

Regional Stakeholders

- Regional Transportation District (RTD)
- Mile High Flood District (MHFD)
- Denver Regional Council of Governments (DRCOG)
- Denver Water
- Xcel Energy
- United Power

Integration with Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is also paramount to the success of this plan. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Thornton, Federal Heights, and Northglenn use a variety of comprehensive planning mechanisms to guide growth and development, such as master plans and ordinances. Integrating existing planning efforts, mitigation policies, and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. Table 2-3 below provides a summary of the key existing plans, studies, and reports that were reviewed during the update process. Information on how they informed the update are noted where applicable.

Table 2-3 Summary of Key Plans, Studies, and Reports

Plan, Study, Report Name	How Plan, Study or Report Informed the HMPC
Comprehensive Plans: Federal Heights 1997, Northglenn 2010, Thornton 2020	Informed the community profiles and capability assessments.
Northglenn Sustainability Plan 2010 and Climate Risk Adaptation and Advisory Report, 2018	Informed the community profile, risk assessment, and climate change sections
Northglenn Energy Action Plan (2019), Integrated Water Resources Plan (2020), and Water Efficiency Plan (2020)	Informed the community profile and risk assessment
Thornton Drought Management Plan (2019), Sustainability Action Agenda (2020), and Water Efficiency Plan (2018)	Informed the community profile and risk assessment
Thornton Energy Action Plan (2020) and Utility Master Plan (2020)	Informed the community profile and risk assessment
Thornton Health Impact Assessment (2012)	Informed the community profile and risk assessment
Thornton Housing Master Plan (2010), Senior Master Plan (2015), and Transportation and Mobility Master Plan (2022)	Informed the community profile and risk assessment
North Suburban Medical Center Hazard & Vulnerability Assessment (2021)	Informed the risk assessment
2017 Thornton, Federal Heights, Northglenn Natural Hazard Mitigation Plan	Review information from previous plan
Local Hazard Mitigation Plans for Adams County (2020), Larimer County (2021), & Weld County (2021)	Informed the community profile, risk assessment, and mitigation strategy
Colorado State Hazard Mitigation Plan (2018)	Reviewed information on past hazard events and hazard risk information to inform the risk assessment; reviewed State goals and objectives
Colorado Drought Mitigation and Response Plan (2018)	Reviewed information on pasts droughts and their impacts on the planning area. Incorporated information into the risk assessment
Colorado Flood Mitigation Plan (2018)	Reviewed information on past flood events and risk analysis for the planning area to inform the risk assessment
Colorado State Demographer Community Demographic Profiles (ACS 5-Year Estimates 2015-2019)	Provide demographic data and trends for the Cities of Thornton, Federal Heights, and Northglenn.
FEMA Flood Insurance Studies for Adams County (2018), Larimer County (2019), and Weld County (2014)	Provided flood risk data for specific hazard areas located within the Cities.
Mile High Flood District Niver Creek & Tributaries Major Drainageway Plan (2016) and Flood Hazard Area Delineation: Niver Creek, Tributary L, & Tributary M (2021)	Informed the flood hazard profile
Standley Lake Security Assessment (2022)	Informed the ground and surface water contamination hazard profile
City of Thornton America's Water Infrastructure Act Risk and Resilience Assessment (2020)	Informed the ground and surface water contamination hazard profile

Phase 2: Assess Risks

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

Chapter 4, Risk Assessment is the result of a comprehensive effort to identify and document all the hazards that have, or could, impact the planning area. This section was updated to reflect recent hazard

events and current assets within Thornton, Federal Heights, and Northglenn. Where data permitted, Geographic Information Systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. The HMPC conducted a capability assessment update to review and document the planning area's current capabilities to mitigate risk and 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 identified. A more detailed description of the risk assessment process and the results are included in Chapter 4. The capability assessment is included in Chapter 3 Community Profile.

Phase 3: Develop the Mitigation Plan

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

Wood facilitated a brainstorm and discussion session with the HMPC during their second meeting to update the goals and objectives from the 2017 plan. During the third HMPC meeting, Wood facilitated a discussion session with the HMPC around a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This included a review of progress on each action identified in the 2017 plan. Several new mitigation actions resulted from this process that were added to the plan in 2023. This process and its results are described in greater detail in Chapter 5.

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, Wood produced a complete first draft of the plan. This complete draft was shared electronically for HMPC review and comment. Other agencies were invited to comment on this draft as well. HMPC and agency comments were integrated into the second draft, which was advertised and distributed to collect public input and comments. Wood integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a final draft for the Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA Region VIII to review and approve, contingent upon final adoption by the City Councils.

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 governing boards of each participating jurisdiction on the dates included in the adoption resolutions in Appendix A.

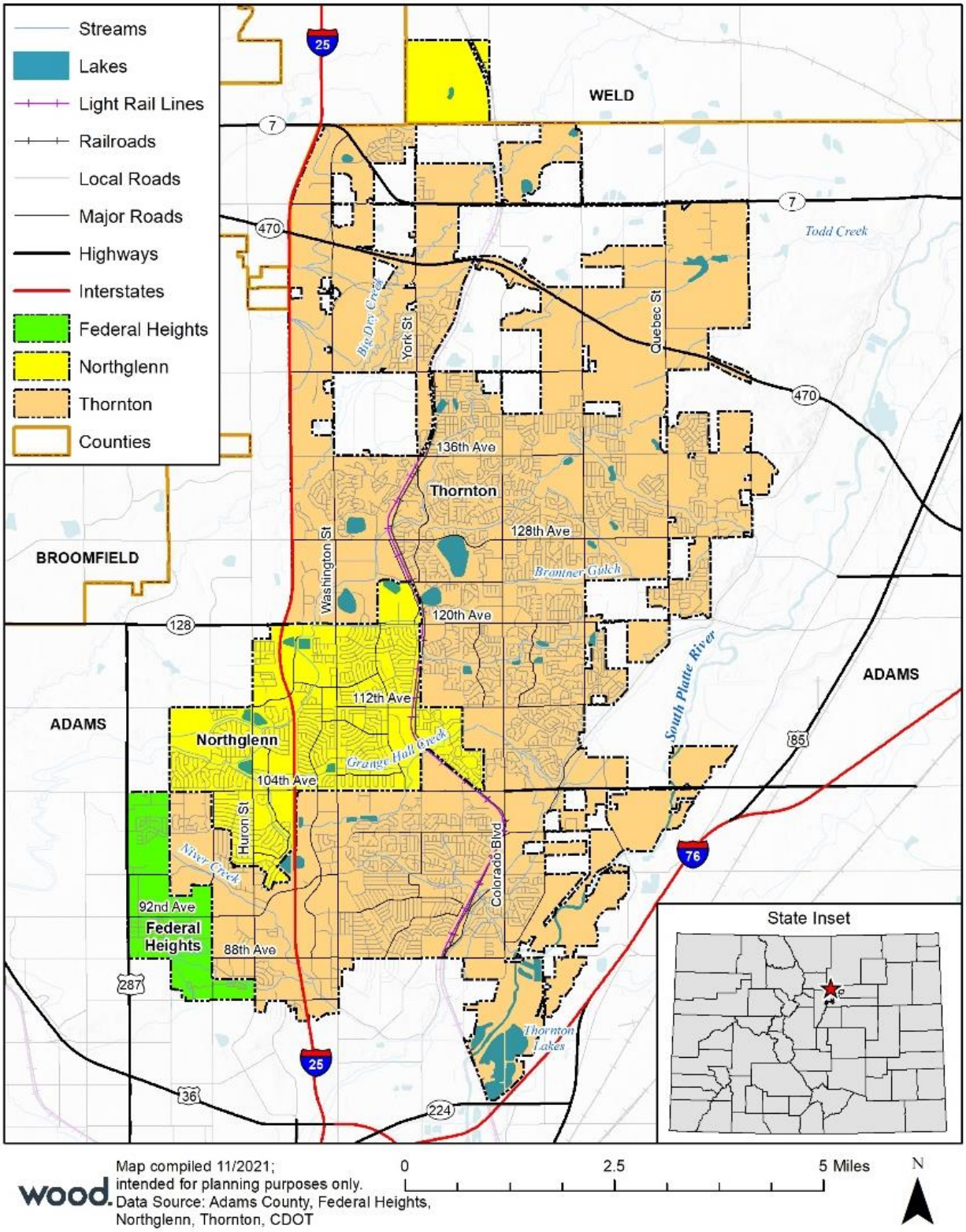
Planning Step 10: Implement, Evaluate, and Revise the Plan

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time. A discussion on the progress with implementation is included in Chapter 5. Each recommended 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 6.

Finally, there are numerous organizations within the planning area 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 Cities of Thornton, Federal Heights, and Northglenn, and is addressed further in Chapter 6. An updated overall implementation strategy and maintenance and a strategy for continued public involvement are also included in Chapter 6.

3 Community Profile

Figure 3-1 Thornton, Federal Heights, and Northglenn Planning Area



The Cities of Thornton, Federal Heights, and Northglenn are adjacently located approximately 10 miles north of the State Capital in Denver in Adams County, Colorado, with part of Northglenn extending into Weld County. Thornton is the largest of the three cities, covering 27.2 square miles. Federal Heights is the smallest city, covering only 1.8 square miles, and the City of Northglenn is 7.5 square miles. These cities are a part of the Denver-Aurora-Lakewood, CO Metropolitan Statistical Area.

Thornton, Federal Heights, and Northglenn are all home rule municipalities, meaning that Colorado has granted these cities the power to exercise local control of their own government and minimize state intervention. The cities in the planning area operate under a council/manager form of government, where the city manager runs the city's day-to-day operations with general guidance from the City Council. The City Council in Thornton and Northglenn are composed of a mayor and eight Council members. In Federal Heights, the City Council consists of one mayor and six Council members. These three cities are each protected by their respective police departments. Federal Heights and Thornton maintain their own fire departments, while Northglenn contracts with the North Metro Fire Rescue District. Federal Heights and Thornton also operate their own dispatch centers, while Northglenn uses the Adams County Communication Center Authority (ADCOM911).

3.1 History

14,000 years ago, the planning area was inhabited by the Folsom Complex, a Paleo-Indian archaeological culture that lived in a large portion of North America. Artifacts from this culture, such as spearheads, have been found in northern portions of Colorado. During the 1500s and 1600s, Spanish and French explorers found the land and claimed ownership. Some of these early explorers and gold miners found the Cheyenne and Arapaho tribes, bison hunting Native Americans already living in the area.

Those living in the United States realized the potential that land in the West had and in 1785, the Land Ordinance Act was created. This act sought to survey and sell land in the United States to repay debts from the Revolutionary War. Townships and Ranges were used as a standard survey unit, which divided land into squares rather than following natural features such as streams and rock formations. Townships consisted of a square plot of land that was further divided into 36 640-acre (or one square mile) sections and sold for a minimum price of $1 per acre.

The land that includes the planning area was acquired by the United States in 1803 as part of the Louisiana Purchase. The Colorado Territory was formed on February 28, 1861, and Colorado was admitted to the Union on August 1, 1876. In 1902, voters approved creation of Adams County which, prior to that time, had been part of an enormous Arapahoe County. The City of Federal Heights was incorporated in 1940, The City of Thornton in 1956, and the City of Northglenn in 1969. See the City Annexes for additional details.

3.2 Geography & Climate

The Cities of Thornton, Federal Heights, and Northglenn are adjacently located in Adams County, Colorado, and southern Weld County. Thornton covers 24,286 acres and is located at an altitude of 5,351 feet above sea level. Thornton is adjacent to the South Platte River and encompasses various lakes. Federal Heights is located to the west of Thornton and Northglenn, has a total area of 1,138 acres, and is 5,292 feet above sea level. Northglenn covers 4,761 acres west of Thornton and northeast of Federal Heights and is located at 5,377 feet in elevation.

The geology of these cities is consistent with the surrounding plains of Colorado. According to the Colorado Geological Survey (CGS), the plains are characterized predominantly by sedimentary rocks. These cities are geographically located on the Colorado Piedmont, a region consisting of a broad hilly valley near the South Platte River, between the high eastern plains and the foothills to the west.

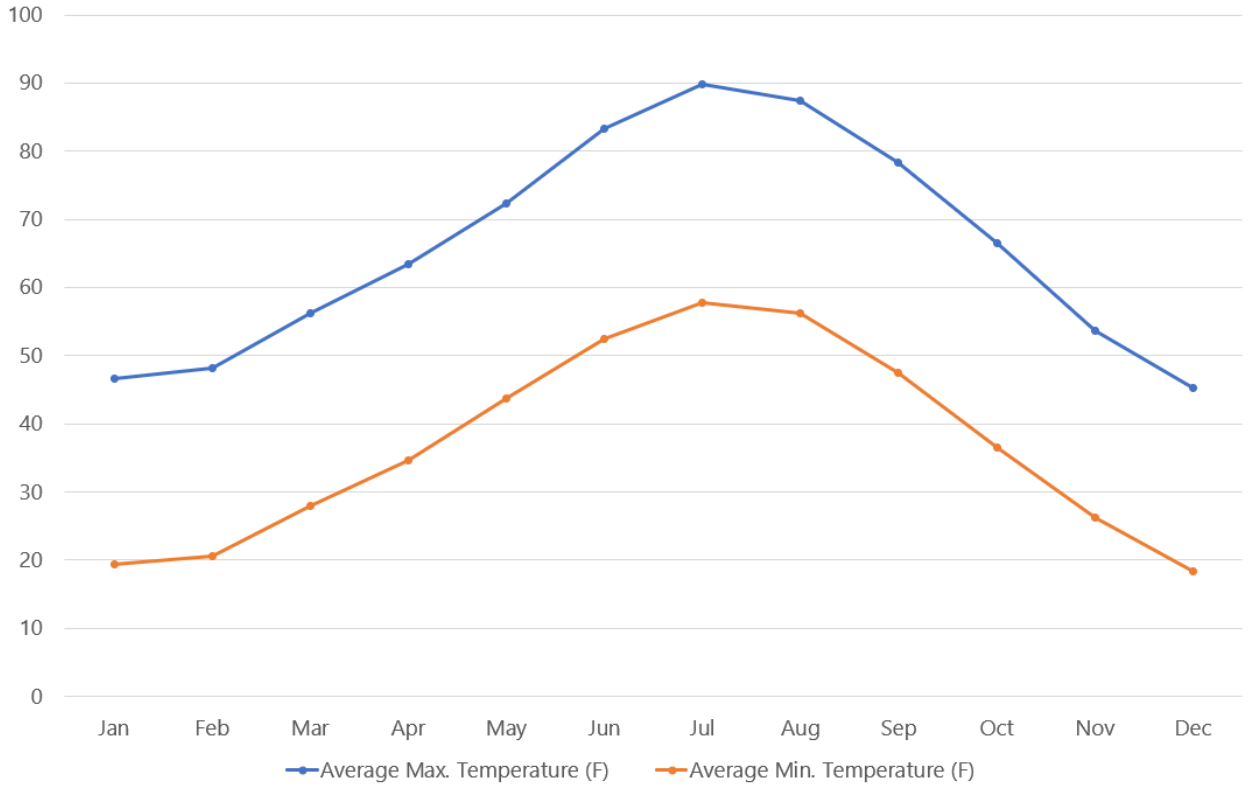
Thornton, Federal Heights, and Northglenn are in a region with a semi-arid climate and four distinct seasons with modest precipitation year-round. Summers range from mild to hot, with generally low humidity and frequent afternoon thunderstorms. Winters range from mild to occasional bitter cold, with periods of sunshine alternating with times of snow, high winds, and very low temperatures. The Western Regional Climate Center (WRCC) reports weather data for the region from the Northglenn Weather Station. Table 3-1 contains temperature and precipitation summaries from the station. Figure 3-2 graphs the average monthly temperature extremes and Figure 3-3 graphs the average monthly precipitation and snowfall for the region.

Table 3-1 Regional Climate Summaries

Climate	Annual Average
Average Max. Temperature (F)	65.9
Average Min. Temperature (F)	36.8
Average Total Precipitation (in.)	14.15
Average Total Snowfall (in.)	42.9
Average Snow Depth (in.)	0

Source: Western Regional Climate Center, www.wrcc.dri.edu/ (2016 is most recent available data)

Figure 3-2 Average Monthly Max and Min Temperature (Fahrenheit) Summary

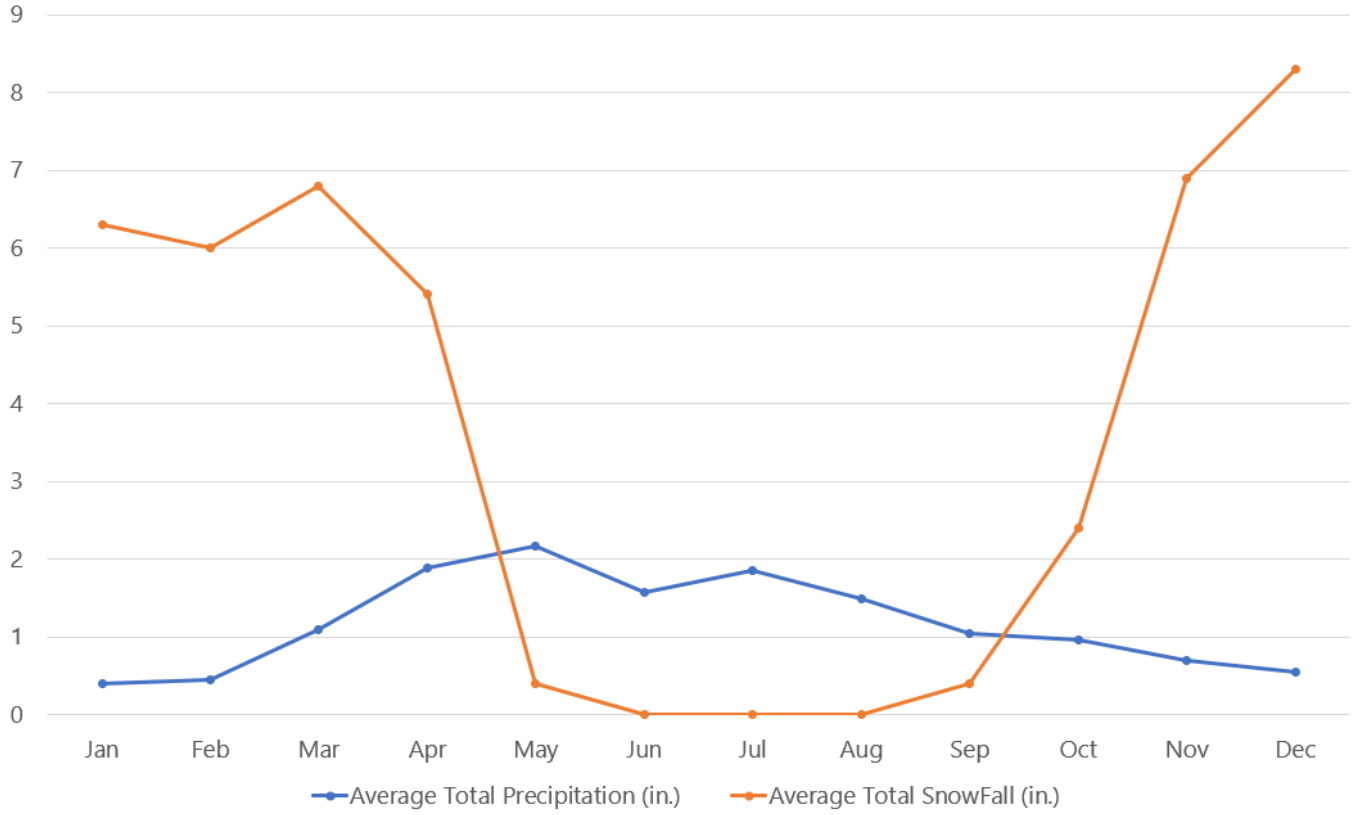


Source: Western Regional Climate Center, www.wrcc.dri.edu/ (2016 is most recent available data)

Figure 3-2 displays how temperatures in the planning area vary significantly from summer to winter months. July and August tend to have the warmest temperatures, averaging nearly 90˚ Fahrenheit in July. In the winter months, particularly in December and January, the region can expect to see average temperatures of below 20˚. The graph also shows that there is typically a 25˚ to 35˚F variation between the average minimum and the maximum monthly temperatures in the region.

Figure 3-3 displays that the average first snowfall in the planning area occurs in September and the average final snowfall occurs in May. The annual average snowfall in the region is 42.9 inches; the month of December alone experiences an average of 8 inches of snowfall. Total annual precipitation is 14.15 inches, occurring mostly in spring and summer. While precipitation is normally highest in the months of April and May, in certain years the summer months can be very dry.

Figure 3-3 Average Monthly Precipitation and Snowfall Summary



Source: Western Regional Climate Center, www.wrcc.dri.edu/ (2016 is most recent available data)

3.3 Demographics

According to the 2020 Census, the combined population of the three cities is 196,924. Thornton comprises 73% of the population (144,186), Northglenn 20% (39,201), and Federal Heights 7% (13,537). This represents a 19% increase since the 2010 Census population of 166,028. Thornton and Federal Heights had the most growth at 21% and 18% respectively, with Northglenn still above the national average at 10%.

The following tables and figures break down key demographic, economic, and social characteristics based on 2020 Census data. As shown in Table 3-2, there are some categories in which the planning area differs significantly from the rest of Colorado and the United States. All three cities in the planning area have a

population with a younger median age than the state and national average, especially in Federal Heights. Additionally, there is a higher housing occupancy rate in the planning area compared to the state and country. While all three cities have higher rates of people living in poverty and people without health insurance when compared to the state and country, the difference is significant in Federal Heights.

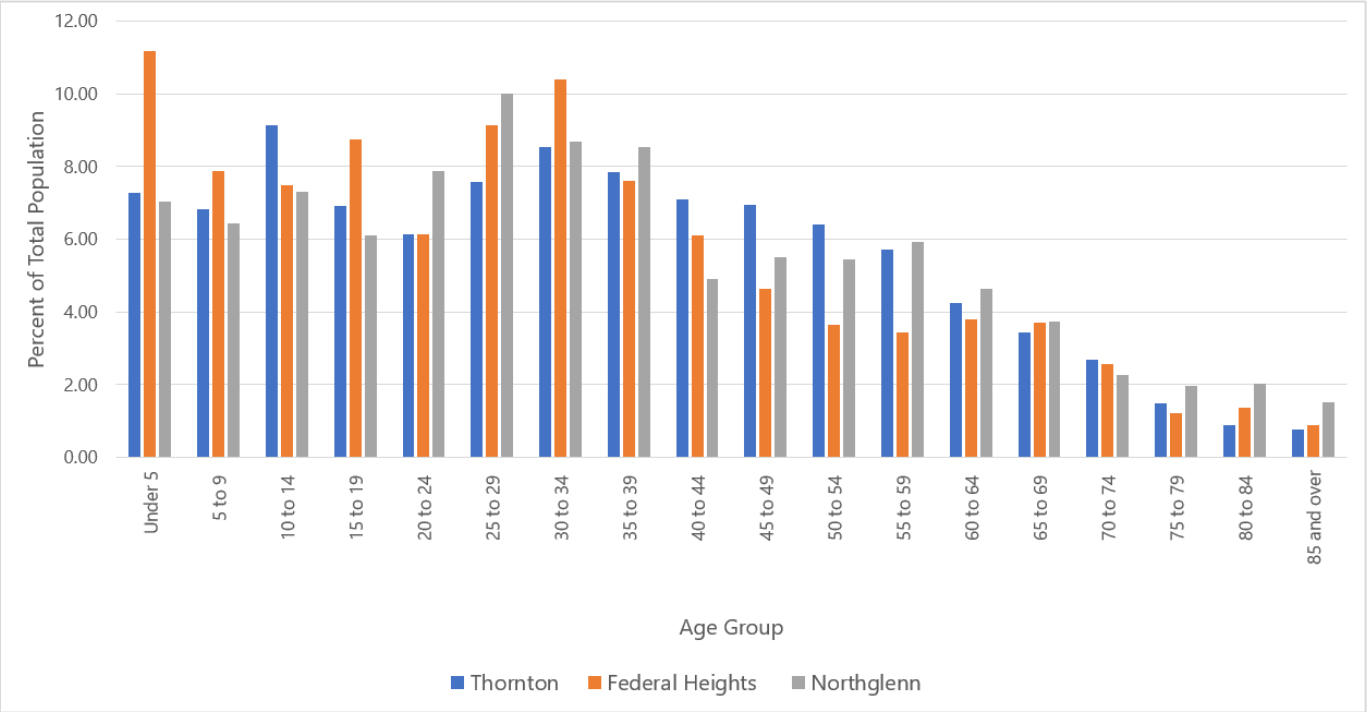
Table 3-2 Demographic and Social Characteristics Compared to the State and the Nation

	Thornton	Federal Heights	Northglenn	Colorado	U.S.
Population	144,186	15,537	39,201	5,773,714	331,449,281
% Growth since 2010	21%	18%	10%	15%	7%
Median Age	33.5	29.6	32.8	36.7	38.1
Housing Occupancy Rate	96.3%	94.3%	95.5%	90.0%	87.9%
% of Housing Units with no Vehicles Available	3.2%	4.7%	5.0%	5.1%	8.6%
Median Home Value	$349,000	$71,700	$331,200	$343,300	$217,500
Unemployment	4.0%	4.7%	4.9%	3.9 %	4.0%
Mean Travel Time to Work (minutes)	30.5	28.1	28.2	25.8	26.9
Median Household Income	$80,732	$49,291	$71,104	$72,331	$62,843
Per Capita Income	$32,589	$22,703	$31,072	$38,226	$34,103
% of Individuals Below Poverty Level	8.5%	21.2%	7.8%	10.3%	13.4%
% Without Health Insurance	9.6%	21.3%	8.8%	7.6%	5.1%
Average Household Size	3.07	3.14	2.89	2.56	2.62
Households with a broadband internet subscription	92.6%	82.5%	86.6%	89.6%	85.2%
% of Population Over 25 with High School Diploma or Higher	87.7%	69.4%	90.1%	91.7%	88.0%
% of Population Over 25 with bachelor's degree or Higher	28.3%	12.2%	20.0%	40.9%	32.1%
% with Disability	7.8%	7.5%	10.1%	10.6%	12.6%
Language other than English spoken at home	24.7%	49.8%	18.3%	16.4%	21.5 %
% Foreign born persons	13.3%	25.7%	10.9%	9.5%	13.5%

Source: U.S. Census Bureau, American Community Survey

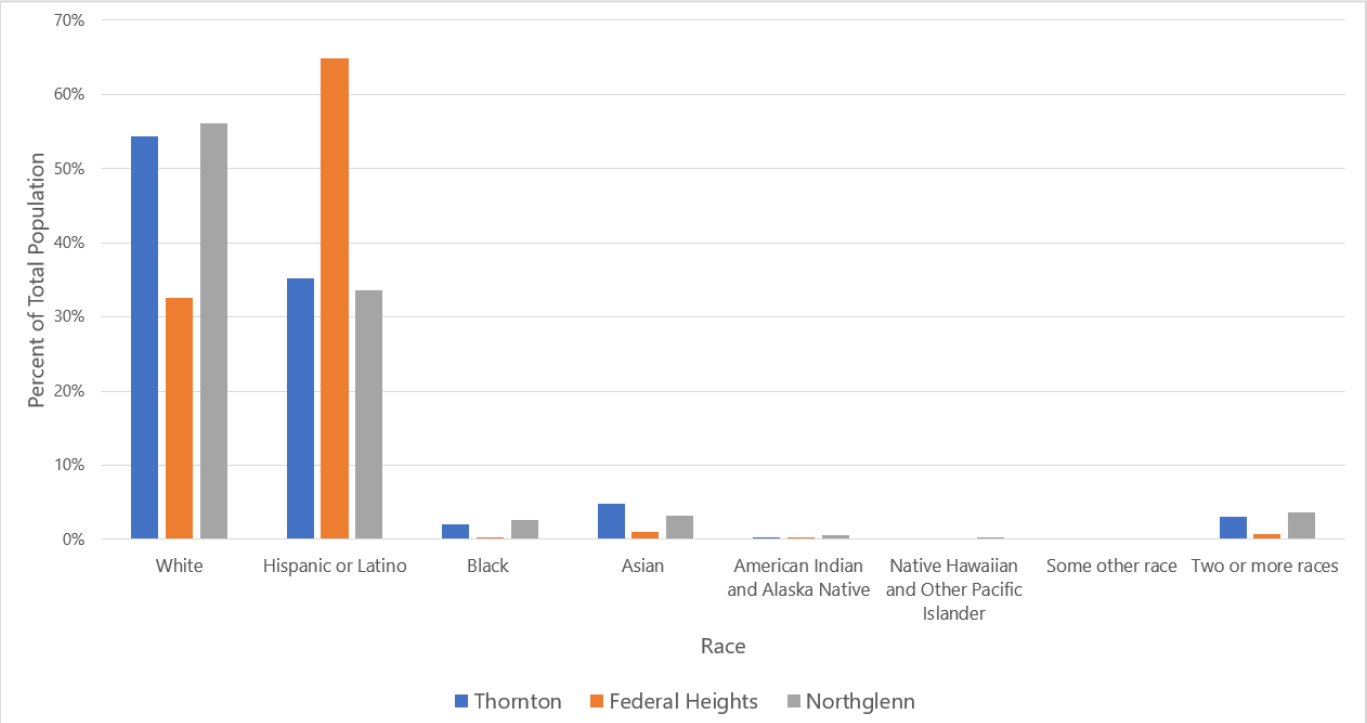
Table 3-2, Figure 3-4, and Figure 3-5 show the comparison of city demographics variables by race, sex, and age for the planning area. Most of the population in all three cities is either White or Hispanic or Latino, with a very small portion of the population being either Black, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islanders, or Other. White is the most populous race in the cities of Thornton and Northglenn, while Hispanic or Latino is the most populous race in the City of Federal Heights. Figure 3-5 summarizes the age breakdown for the three cities. While the same general age trend can be seen across the cities, Federal Heights does have a notably younger population compared to the other two cities.

Figure 3-4 City Demographic Breakdown by Age Group



Source: U.S. Census Bureau, American Community Survey

Figure 3-5 City Demographic Breakdown by Race



Source: U.S. Census Bureau, American Community Survey

3.4 Housing

Table 3-3 displays the types and amount of housing units in each of the three cities in the planning area. Thornton and Northglenn have comparable housing types and amounts, with one unit detached style housing being the most popular type in both cities. Federal Heights shows significantly different housing trends, with mobile homes comprising 46% of the housing stock. This is also reflected in the mean home values, which are close to the state average in Thornton and Northglenn, but significantly lower in Federal Heights.

Table 3-3 Types and Total Amounts of Housing Units by City

Type of Housing Units	Thornton	%	Federal Heights	%	Northglenn	%
Total housing units	46,868	-	4,317	-	13,496	-
Median home value	$349,000		$71,700		$331,200	
1, detached	30,032	64.1%	833	19.3%	7,996	59.2%
1, attached	4,334	9.2%	124	2.9%	1,180	8.7%
2 apartments	113	0.2%	14	0.3%	76	0.6%
3 or 4 apartments	1,344	2.9%	125	2.9%	442	3.3%
5 to 9 apartments	2,059	4.4%	265	6.1%	762	5.6%
10 or more apartments	6,290	13.4%	972	22.5%	3,020	22.4%
Mobile home or other type of housing	2,696	5.8%	1,984	46.0%	20	0.1%

Source: U.S. Census Bureau, American Community Survey

3.5 Economy

3.5.1 Income

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

Based on U.S. Census Bureau estimates, per capita income in the planning area in 2020 varied between cities. Table 3-4 compares economic factors between Thornton, Federal Heights, and Northglenn. The City of Thornton had the highest average household income at $80,732 and highest per capita income at $32,589. Federal Heights had the lowest average household income at $49,291 and a per capita income at $22,703. Northglenn comes in between the two with $71,104 average household income and per capita income of $31,072.

Federal Heights also had a significantly higher portion of the population living below the poverty level, at 21.2%, and has the lowest percent of the population in the labor force. The median home value is comparable between Thornton and Northglenn at over $330,000. Federal Heights has a notably lower median home value of $71,700, due primarily to the high percentage of mobile homes compared to the other two cities. However, the median gross rent between all three cities is nearly the same.

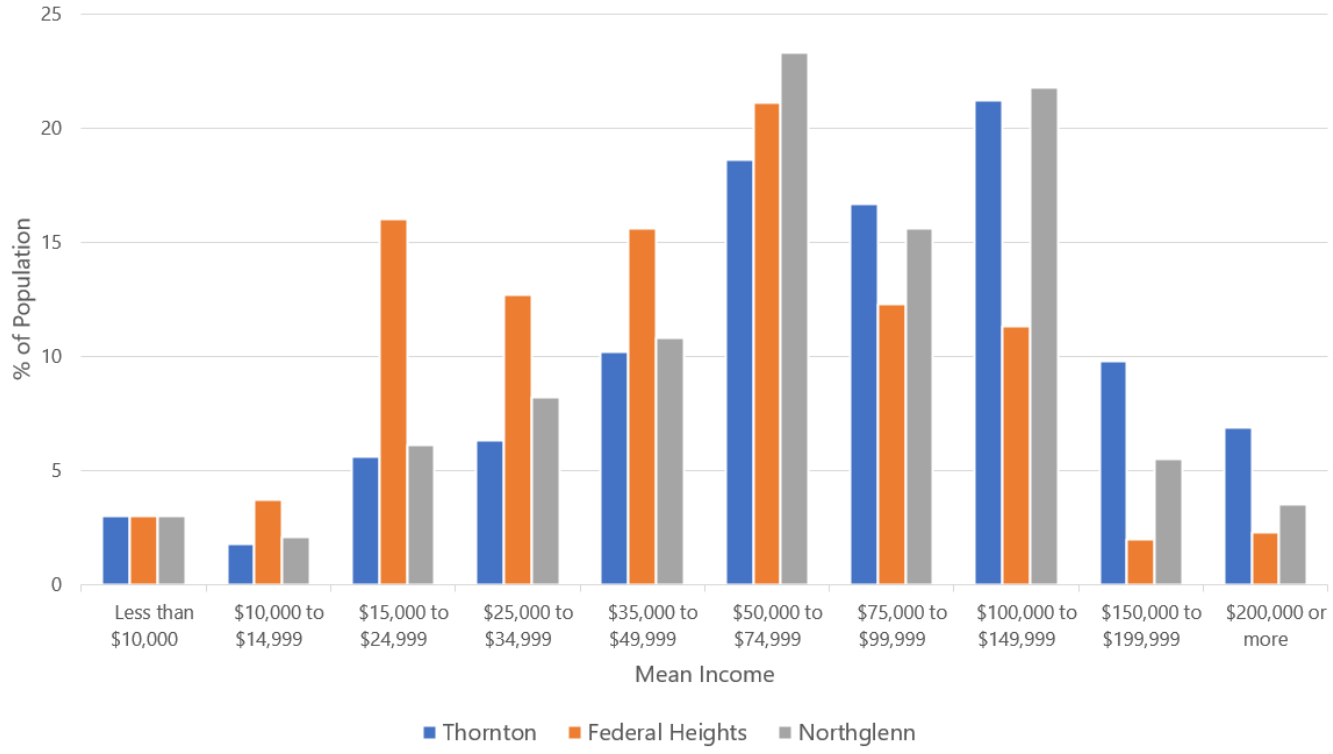
Table 3-4 Economic Comparison by City

	Thornton	Federal Heights	Northglenn
Median household income	$80,732	$49,291	$71,104
Per capita income	$32,589	$22,703	$31,072
% of Individuals below poverty level	8.5%	21.2%	7.8%
Median home value	$349,000	$71,700	$331,200
Median gross rent	$1,485	$1,324	$1,372
% of Population 16 years+ in Labor Force	72.9%	70.9%	71.9%

Source: United States Census Bureau 2016-2020

Figure 3-6 compares the mean income between the three cities in the planning area. This graph shows that income trends are comparable between Thornton and Northglenn, but Federal Heights displays several differences. In Federal Heights, there is a significantly higher portion of the population in the lower income range ($15,000-$24,999) and significantly fewer people in the higher income range ($100,000-$149,999) than the other two cities. This indicates that the average total income in Federal Heights is lower than the other two cities in the planning area.

Figure 3-6 Mean Income by City



Source: United States Census Bureau 2016-2020

3.5.2 Occupations and Industries

According to 2020 American Community Survey data, the planning area's occupation and industry economy also differ slightly between cities. In the Cities of Thornton and Northglenn, the education, health care and social assistance industry employs the largest portion of the population, with 16.08% of total employment in Thornton and 14.96% in Northglenn. In the City of Federal Heights, construction is

the largest employer, making up 18.6% of the total employment in the City. Table 3-5 shows the distribution of industry types in the three cities in the planning area.

Table 3-5 Distribution of Industry Type by City

	Thornton	Federal Heights	Northglenn
Full-time, year-round civilian employed population 16 years and over	55,015	4,290	16,100
Agriculture, forestry, fishing and hunting, and mining:	1,113	150	243
Construction	6,363	798	1,972
Manufacturing	5,395	442	1,863
Wholesale trade	2,308	100	737
Retail trade	5,840	468	1,971
Transportation and warehousing, and utilities:	3,828	115	1,177
Information	2,095	64	318
Finance and insurance, and real estate and rental and leasing	3,512	317	1,152
Professional, scientific, and management, and administrative and waste management services	6,392	396	1,697
Educational services, and health care and social assistance	8,848	467	2,409
Arts, entertainment, and recreation, and accommodation and food services	3,106	672	1,165
Other services, except public administration	2,460	215	594
Public administration	3,755	86	802

Source: United States Census Bureau

3.6 Social Vulnerability

Social vulnerability refers to a community's capacity to prepare for and respond to hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human caused threats, such as toxic chemical spills. Social vulnerability considerations were included in this plan update to identify areas across the planning area that might be more vulnerable to hazard impacts based on a variety of factors.

The term vulnerability should be used to describe the communities more vulnerable to a risk or hazard, such as high vulnerability due to wildfires or floods based upon geography, topography, hydrology, or weather. Referencing people themselves directly with the term vulnerability causes individual community members to be seen with a deficit lens, leaving the impression that the vulnerability is a result of the lack of responsibility and/or adequate planning of the individual. Instead, vulnerability only occurs when the system that the individual is part of fails to provide equitable accessibility to resources or services, known as access and functional needs, for the individual to survive, respond to, and recover from an event. Barriers that may be exacerbated by certain social and economic factors – including race, age, income, renter status, or institutionalized living – directly affect a community's ability to prepare for, respond to, and recover from hazards and disasters. The concept of social vulnerability helps explain why communities often experience a hazard event differently, even when they experience the same physical impacts or property loss.

The Center for Disease Control and Prevention (CDC) has developed a social vulnerability index (SVI) to measure the resiliency of communities when confronted by external stresses such as natural or human-caused disasters. The SVI is broken down by county to the census tract level and provides insight into particularly vulnerable populations. Data for Adams County was used to gain an understanding of the vulnerabilities that are present in the Cities of Thornton, Federal Heights, and Northglenn. This data is used to assist emergency planners and public health officials in identifying what communities are more likely to require additional support before, during, and after a hazardous event. The SVI index combines four main themes of vulnerability, which are in turn broken down into subcategories for a total of 15 vulnerability factors. Table 3-6 displays those 15 factors and shows how Adams County compares to other counties in Colorado and the country. The rankings show the percentage of counties that Adams County is more vulnerable than, i.e., high numbers indicate a greater vulnerability than other Counties and therefore are at higher risk.

Table 3-6 Social Vulnerability Indicators for Adams County

Theme	Variable	Ranking Compared to Colorado Counties	Ranking Compared toUS Counties	Vulnerability
Socioeconomic status		65%	40%	Below Average
	Below poverty	44%	28%	Below Average
	Unemployment	46%	31%	Below Average
	Income	48%	31%	Below Average
	No high school diploma	94%	74%	High
Household composition and disability		63%	40%	Below Average
	Age 65 or older	0%	1%	Low
	Age 17 or younger	95%	93%	High
	Disability	33%	9%	Low
	Single-parent households	95%	85%	High
Minority status and language		98%	94%	High
	Minority	95%	88%	High
	Speaking English “less than well”	95%	94%	High
Housing and transportation		65%	55%	Above Average
	Multiunit structures	83%	95%	High
	Mobile homes	35%	30%	Below Average
	Crowding	95%	93%	High
	No vehicle	52%	32%	Below Average
	Group quarters	24%	9%	Low
Overall Social Vulnerability		**79%**	**59%**	Above Average

Source: U.S. CDC https://svi.cdc.gov (using data from U.S. Census Bureau American Community Survey, 2014-2018)

Adams County’s social vulnerability is above average overall compared to the rest of the United States,and high compared to the rest of Colorado:

- Socioeconomic vulnerability is generally below average, but the County has a relatively high number of people who do not have high school diplomas.
- Adams County has a low percentage of elderly and people with disabilities. However, it has a high percentage of children and single-parent households.
- Adams County has a high percentage of racial minorities, who historically are hardest hit by disasters, as well as people who speak English “less than well,” complicating disaster communications.
- A high percentage of Adams County residents live in multi-unit structures, or in housing units with more people than rooms, which can complicate evacuation.

Figure 3-7 through Figure 3-11 display SVI data for the planning area by census tract.

Figure 3-7 Overall Social Vulnerability in the Planning Area

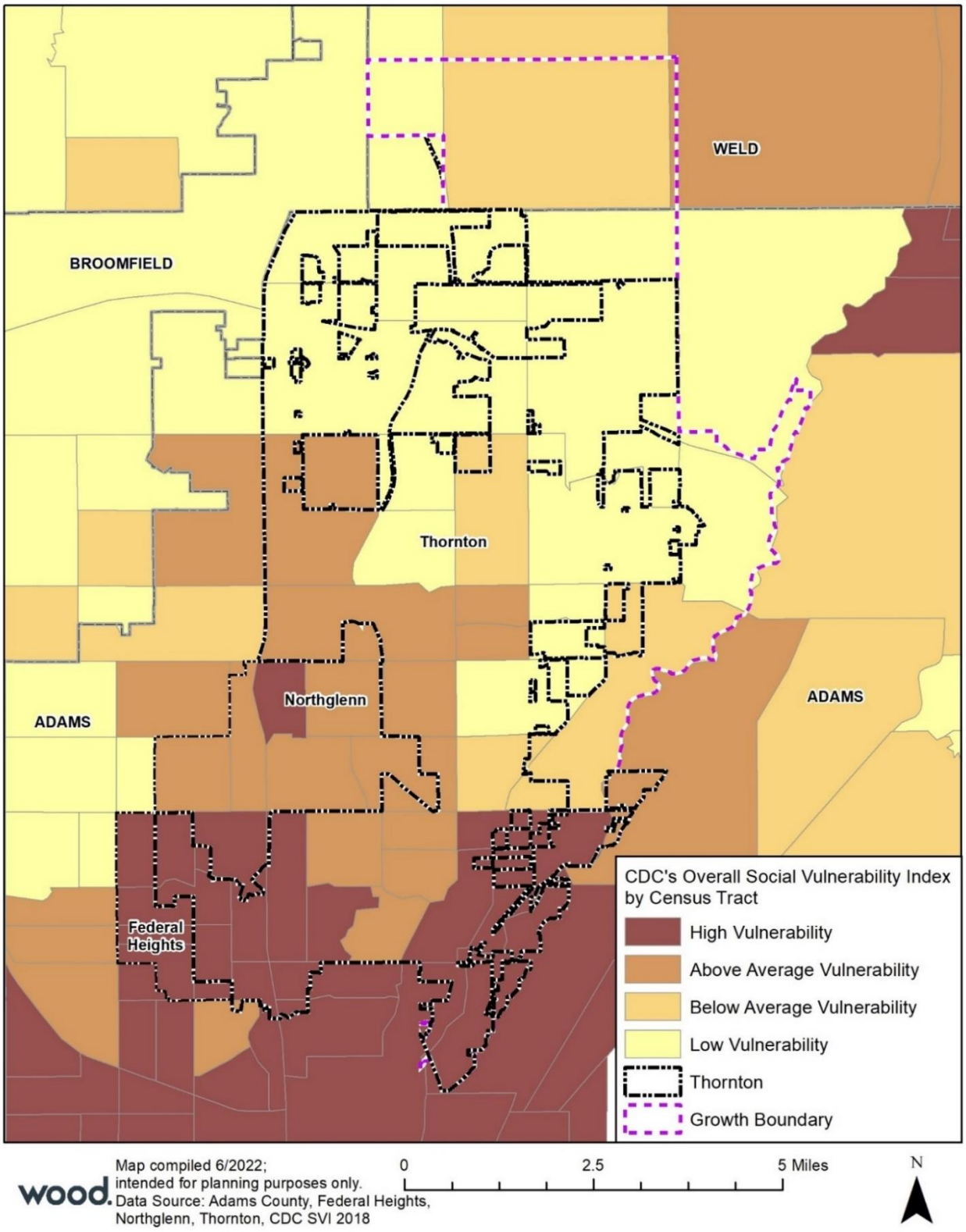


Figure 3-8 Social Vulnerability – Socioeconomic Status

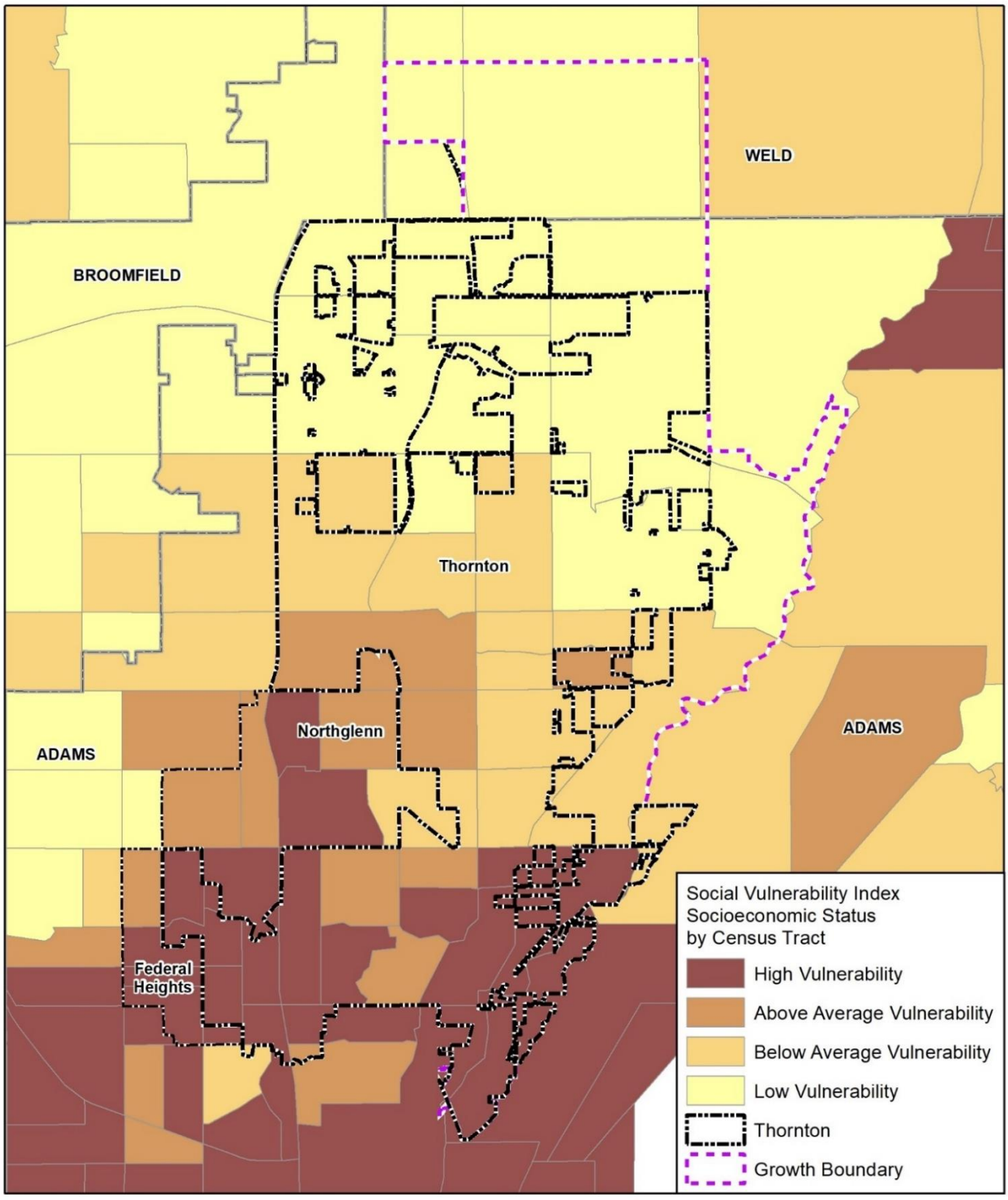


Figure 3-9 Social Vulnerability – Household Composition and Disability

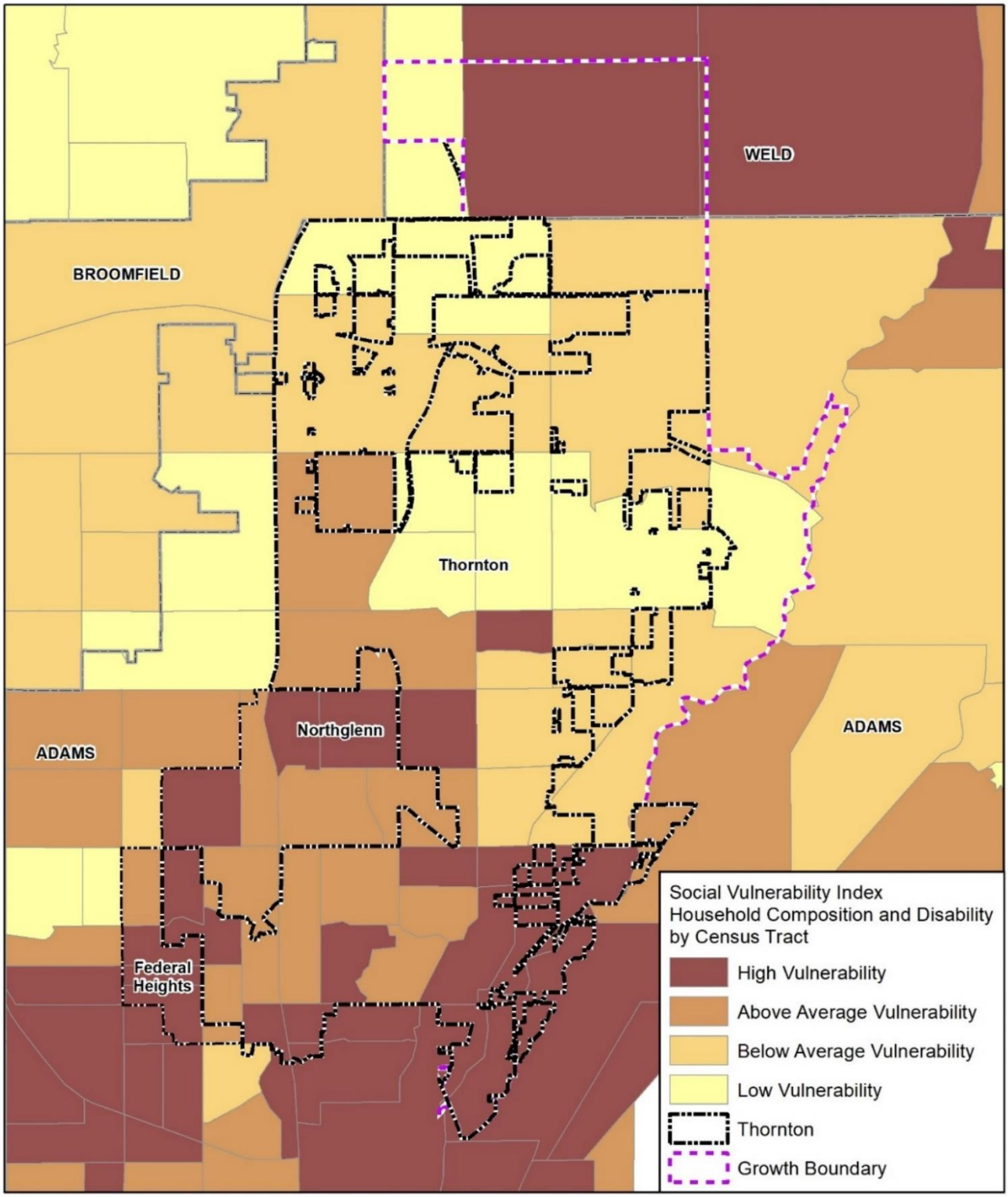


Figure 3-10 Social Vulnerability – Minority Status and Language Vulnerability

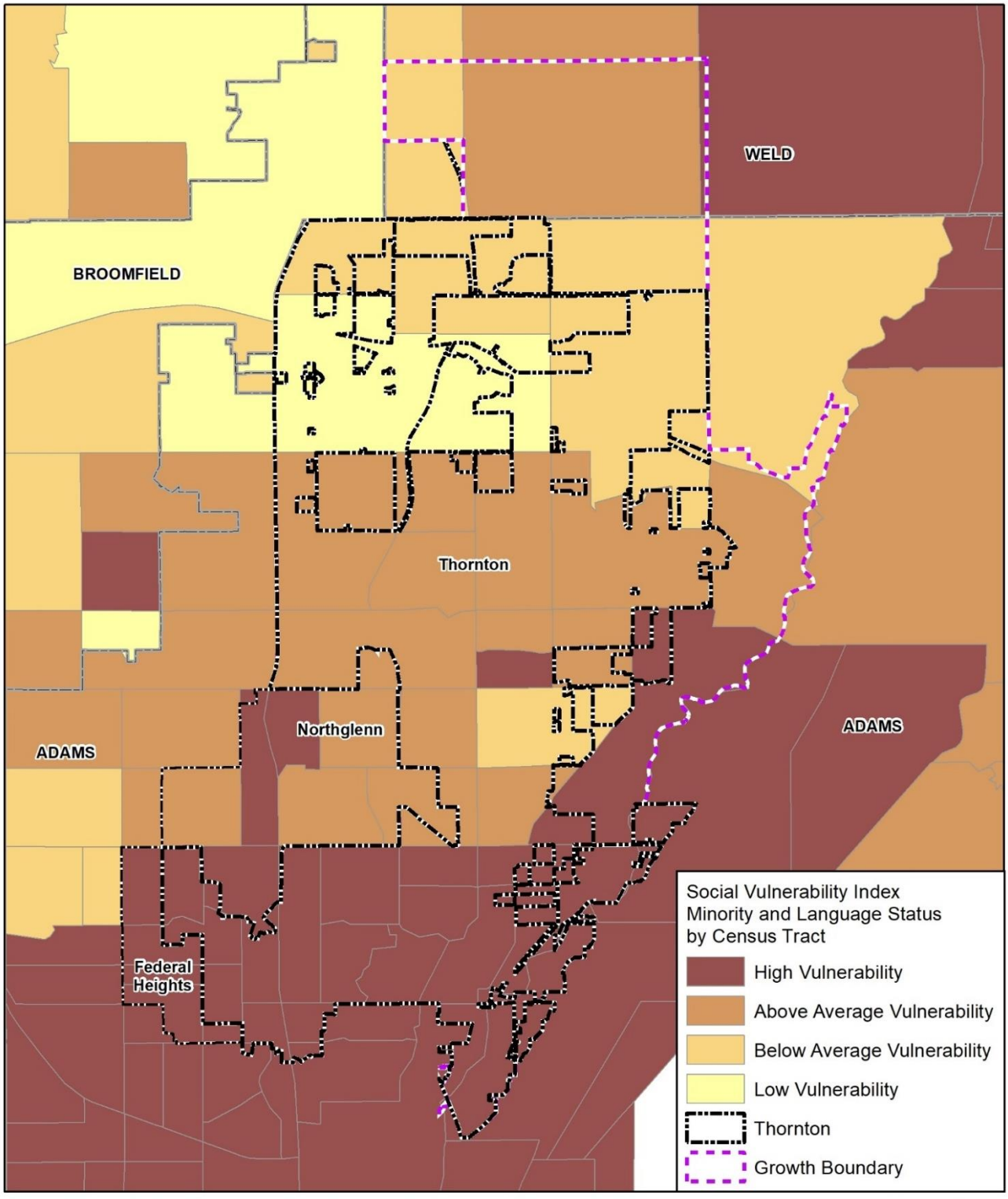
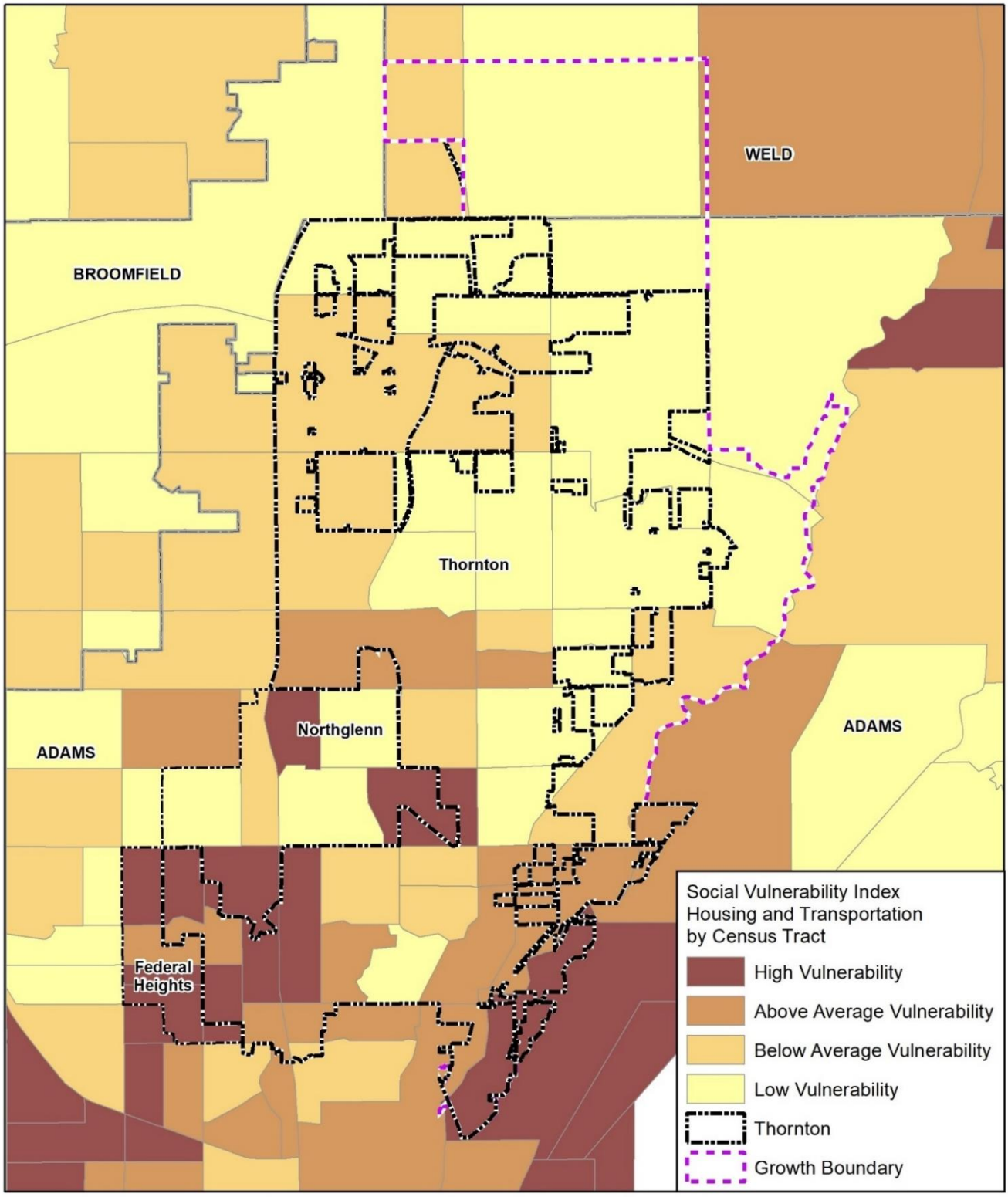


Figure 3-11 Social Vulnerability – Housing and Transportation Vulnerability



Based on this data, the areas with the highest level of social vulnerability are in the western portion of the County, where Federal Heights and portions of Thornton and Northglenn are located. It should be noted that even though a city may have relatively fewer people in a SVI category compared to other counties, there are still people in that category who may be disproportionately impacted by disasters.

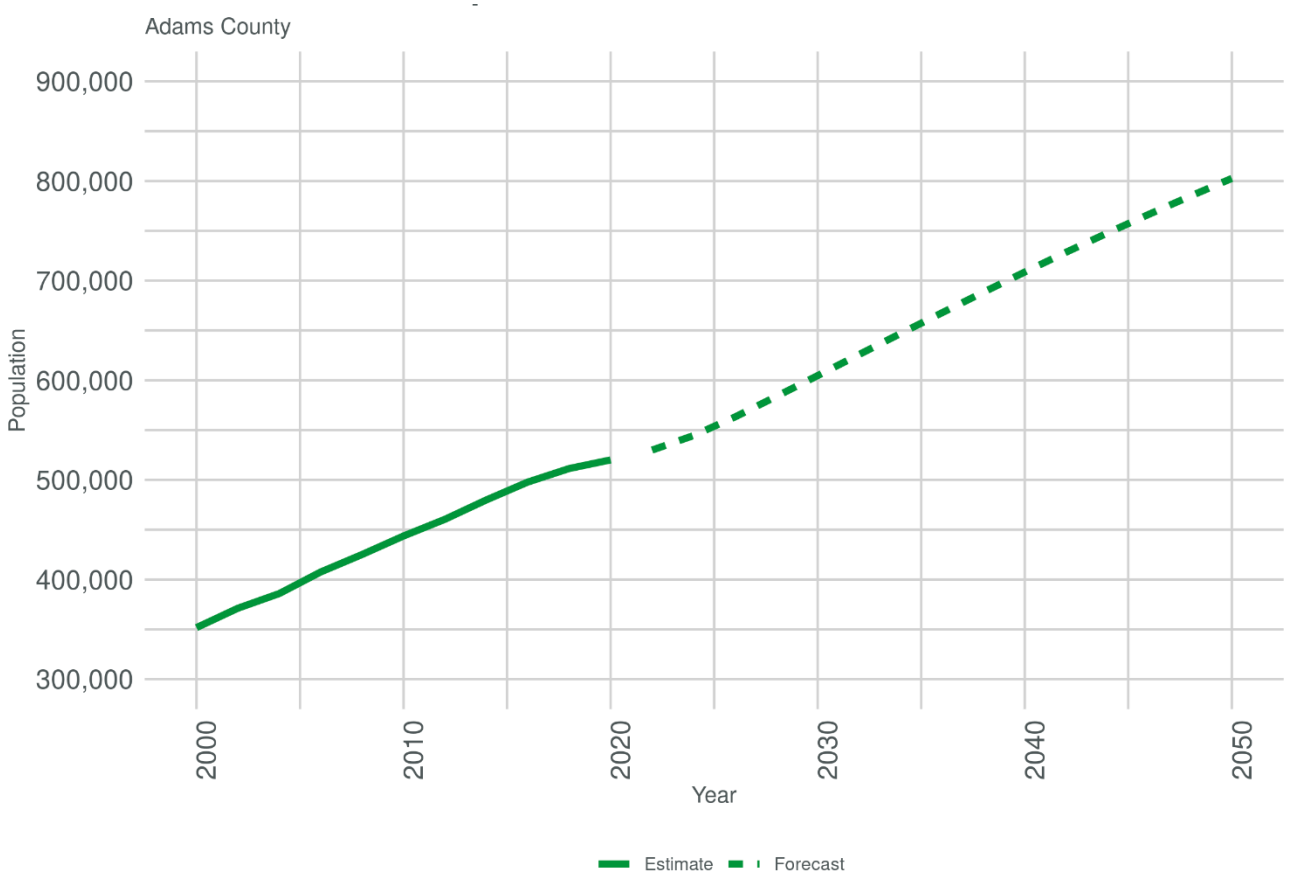
Additional information on the CDC's Social Vulnerability Index can be found at https://svi.cdc.gov.

3.7 Future Population Growth and Development Trends

A key strategy for reducing future losses in a community is to avoid development in known hazard areas and to enforce the development of safe structures in other areas. The purpose of this strategy is to keep people, businesses, and buildings out of harm's way before a hazard event occurs.

According to the Colorado State Demography Office, between 2020 and 2050 Adams County's population is projected to grow at an average of 1.6% a year; this is above the State's projected growth rate of 1.1% over the same time period. The County's population is projected to exceed 600,000 by the year 2027, 700,000 by 2036, and 800,000 by 2045. The State Demography Office does not project population growth below county level, but the planning area can expect to see growth similar to the county overall.

Figure 3-12 Adams County Population Forecast, 2000 to 2050



Source: Colorado State Demography Office

Thornton, Federal Heights, and Northglenn will incorporate information from this HMP update to inform strategic decision making. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

3.8 Hazard Mitigation Capability Assessment

The capability and resource assessment examines the cities' ability to implement and manage the comprehensive mitigation strategy laid out in this Plan. The cities' strengths, weaknesses, and resources are identified here as a means for evaluating and maintaining effective and appropriate management of the hazard mitigation program.

The information included in the capability assessment was gathered primarily from HMPC members and other representatives of the participating agencies. The 2023 update process afforded an opportunity to review these capabilities, how those capabilities have changed since the previous plan, as well as opportunities to expand on or improve existing policies and programs. Chapter 5 includes mitigation actions aimed at improving community capability to reduce hazard risk and vulnerability. Together, the capabilities outlined in this plan highlight both strengths and areas of improvement that the cities should consider to mitigate hazard impacts, reduce risk to life and property, and build a disaster resilient community.

The Cities of Thornton, Federal Heights, and Northglenn have a robust system of plans, programs, and personnel in place to address hazard mitigation and the implementation of a proactive HMP directly and indirectly. These plans include comprehensive plans, zoning plans, and several specific ordinances directed at flood damage prevention, zoning, construction, and development. It takes cooperation and coordination on the part of all city departments and regional organizations to successfully implement the mitigation plan. The cities have various personnel working in GIS, planning and development, public safety communication, public works, and other departments to coordinate the planning, mitigation, and response to natural hazard events. The cities also may coordinate with Adams, Larimer, and Weld County departments to respond to a hazard event. In addition to the traditional FEMA funding mechanisms, the cities can obtain funds for hazard mitigation projects through community development block grants, capital improvement project funds, taxes, and fees.

3.8.1 Legal and Regulatory Capabilities

The following tables list planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Cities of Thornton, Federal Heights, and Northglenn.

Table 3-7 Planning and Regulatory Mitigation Capabilities

Planning & Regulatory Tools (ordinances, codes, plans)	Thornton	Federal Heights	Northglenn
Comprehensive/Master Plan	Yes	Yes	Yes
Zoning ordinance	Yes	Yes	Yes
Subdivision ordinance	Yes	No	Yes
Growth management ordinance	Yes	No	No
Floodplain ordinance	Yes	Yes	Yes
Stormwater Program, Plan, or Ordinance	Yes	Yes	Yes
Other hazard-specific ordinance or plan	Yes	Yes	No
Building codes year	Yes: 2022	Yes: 2018	Yes: 2018
Building Code Effectiveness Grading Schedule (BCEGS) Rating	N/A	N/A	N/A
Erosion or sediment control program	Yes	No	Yes
Site plan review requirements	Yes	Yes	Yes
Capital improvement plan	Yes	Yes	Yes
Economic development plan	No	Yes	Yes
Continuity of Operations Plan (COOP)	Yes	No	No
Local emergency operations plan	Yes	Yes	Yes

Planning & Regulatory Tools (ordinances, codes, plans)	Thornton	Federal Heights	Northglenn
Community Wildfire Protection Plan (CWPP)	No	No	No
Participates in NFIP	Yes	Yes	Yes
Community Rating System (CRS)	Yes: Class 6	No	No
Flood insurance study or other engineering study for streams	Yes	Yes	Yes
Floodplain Management Plan	No	Yes	Yes
Elevation certificates (for floodplain development)	Yes	Yes	No*

* Development in floodplain not allowed per 1975 ordinance. ECs for pre-1975 structures not collected.

Laws, Ordinances, and Agencies

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

Federal

Federal Emergency Management Agency

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

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

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program (HMGP) funds are available to communities. This plan is designed to meet the requirements of DMA, improving the City's eligibility for future hazard mitigation funds.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. The Cities of Thornton, Federal Heights, and Northglenn participate in the NFIP and has adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, all three cities are in good standing with NFIP requirements.

Table 3-8 National Flood Insurance Program Participation

CID	Community	Initial Firm Identified	Current Effective Map Date	Policies in Force	Total Coverage	# of Claims Paid	Total Losses Paid
080240	Federal Heights	04/15/1986	12/02/2021	8	$903,000	6	$21,217
080257	Northglenn	09/15/1978	12/02/2021	15	$5,450,000	4	$3,152
080007	Thornton	06/15/1978	12/02/2021	50	$13,476,900	11	$33,770

Source: FEMA

Community Rating System (CRS)

The City of Thornton also participates in the Community Rating System (CRS), a voluntary program for NFIP participating communities focused on reducing flood damages to insurable property and encouraging a comprehensive approach to floodplain management. The CRS rewards communities that go above and beyond the minimum floodplain management requirements and develop extra measures to reduce flood risk by providing discounts to flood insurance premiums. Credit points are assigned for activities and actions in public information, mapping and regulation, flood damage reduction, and flood preparedness. Participating communities then receive a rating from 10 (lowest) to 1 (highest). Table 3-9 shows the estimated savings for each of the three cities.

The City of Thornton has participated in the CRS since 1994, and currently holds a Class 6 rating. This equates to a 20% discount on all NFIP policies in the City, saving policy holders around $7,000 per year. Each Class improvement would translate into roughly $1,700 in additional savings per year.

Table 3-9 Community Rating System Statistics

CRS Class	% Discount	Federal Heights Annual Savings	Northglenn Annual Savings	Thornton Annual Savings
1	45%	$1,073	$8,860	$15,383
2	40%	$954	$7,890	$13,685
3	35%	$834	$6,919	$11,988
4	30%	$715	$5,949	$10,291
5	25%	$596	$4,978	$8,594
6	20%	$477	$4,008	**$6,897***
7	15%	$358	$2,974	$5,145
8	10%	$238	$2,004	$3,448
9	5%	$119	$1,034	$1,751
10	0%	$0	$0	$0

Source: FEMA Community Information Systems
* Thornton's current CRS class and savings

The Cities of Federal Heights and Northglenn do not currently participate in the CRS program. If Northglenn were to join the CRS program, it could save its NFIP policy holders around $1,000 annually for each class. Due to the low number of policies in Federal Heights, CRS certification would result in savings of only around $100 annually per class.

State and Regional

Colorado Division of Homeland Security and Emergency Management

Pursuant to House Bill 12-1283, the former Division of Emergency Management moved from the Department of Local Affairs to the Division of Homeland Security and Emergency Management under the Colorado Department of Public Safety, effective July 1, 2012. The division is comprised of four offices:

- Office of Emergency Management
- Office of Grants Management
- Colorado Information Analysis Center
- Chief of Staff Office

The mission of the Division of Homeland Security and Emergency Management is: "To lead and support Colorado's effort to prevent, protect, mitigate, respond to and recover from all hazards events." The Division's vision is: A prepared, safe and resilient Colorado."

Colorado Water Conservation Board

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

Colorado Geological Survey

The Colorado Geological Survey is a non-regulatory state government agency within the Colorado School of Mines. The mission of CGS 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 State Forest Service

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

Adams County Office of Emergency Management

The Cities of Thornton, Federal Heights, and Northglenn are located within Adams County. The Adams County OEM plans, coordinates, and supports activities that help the county reduce its vulnerability to disaster. The Adams County OEM works with the local municipalities and fire districts to ensure a coordinated response and share available resources. The OEM also works with TCHD and neighboring Arapahoe, Boulder, Broomfield, Denver, Jefferson, Morgan, Washington, and Weld Counties, to share best practices and provide county-to-county mutual aid when needed. The office oversees the County Emergency Operations and Recovery Plan; exercise and training; public education and preparedness outreach; Community Right-to-Know and Local Emergency Planning Committee; ambulance licensing; and whole community planning.

3.8.2 Administrative and Technical Capabilities

Table 3-10 identifies the cities' personnel responsible for activities related to mitigation and loss prevention in the Cities of Thornton, Federal Heights, and Northglenn.

Table 3-10 Administrative/Technical Mitigation Capabilities

Administrative/Technical Resources	Thornton	Federal Heights	Northglenn
Planner/engineer with knowledge of land development/land management practices	Yes	Yes	Yes
Planner/engineer/scientist with an understanding of natural hazards	Yes	Yes	No
Engineer/professional trained in construction practices related to buildings and/or infrastructure	Yes	Yes	Yes
Resiliency Planner	No	No	No
Transportation Planner	Yes	No	No
Personnel skilled in GIS	Yes	Yes	Yes
Full time building official	Yes	Yes	Yes
Floodplain manager (required for NFIP participants)	Yes	Yes	Yes
Emergency manager	Yes	Yes	Yes P/T
Grant writer	No	Yes P/T	Yes
GIS Data Resources (Hazard areas, critical facilities, land use, building footprints, etc.)	Yes	Yes	Yes
Warning Systems: Sirens	No	No	No
Warning Systems: Reverse 911	Yes	Yes	Yes
Warning Systems: Code Red	Yes	Yes	Yes
Warning Systems: IPAWS/Wireless Emergency Alerts	Yes	No	No

Note: P/T = Part Time

3.8.3 Financial Capabilities

Table 3-11 identifies financial tools or resources that Cities of Thornton, Federal Heights, and Northglenn could use to help fund mitigation activities.

Table 3-11 Financial Mitigation Capabilities

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

Note: Avail = Available to use but has not been used in the past

3.8.4 Education and Outreach

Table 3-12 lists additional education and outreach capabilities, such as specific programs, which the Cities of Thornton, Federal Heights, and Northglenn utilizes to implement hazard mitigation activities.

Table 3-12 Education & Outreach Mitigation Capabilities

Education & Outreach Programs	Thornton	Federal Heights	Northglenn
Past or ongoing public education that address mitigation, such as for flood or fire safety, household preparedness, responsible water use, or environmental education.	Yes	Yes	Yes
Local Citizen Groups That Communicate Hazard Risks	Yes	Yes	No
Firewise	No	No	No
StormReady	County	County	County

3.8.5 Opportunities for Enhancement

Based on the capability assessment, the Cities of Thornton, Federal Heights, and Northglenn have several existing mechanisms in place that already help to mitigate hazards, including numerous planning tools and many available funding mechanisms. These programs should be maintained and reviewed periodically to proactively mitigate natural hazards in the community. The 2023 update provided the cities 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. Specifics can be found in the City Annexes.

4 Hazard Identification and Risk Assessment

Requirement §201.6(c)(2) of the 2000 Disaster Mitigation Act (DMA)
[The plan shall include] A risk assessment that provides 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. The risk assessment shall include:
(i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
(ii) A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of:
(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
(B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;
(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

A key step in preventing disaster losses in our communities involves building a clear understanding of the hazards that pose risks to our residents, businesses, and visitors. For this plan, the following terms facilitate comparisons between communities and can be found throughout the risk assessments and mitigation strategies.

- **Hazard:** Event, incident, or physical condition that has the potential to cause fatalities, injuries, property damage, (critical) infrastructure damage, agricultural loss, damage to the environment, interruption of business, other types of harm or loss.
- **Vulnerability:** Degree of susceptibility to physical injury, harm, damage, or economic loss; depends on an asset's construction, contents, and economic value of its functions.
- **Risk:** Product of a hazard's likelihood of occurrence and its consequences to society; the estimated impact that a hazard would have on people, services, critical infrastructure, and structures in a community. Risk can thus be seen as where hazards intersect with vulnerabilities.

This risk assessment follows the four-step methodology described in FEMA's 2013 Local Mitigation Planning Handbook:

1. Describe Hazards
2. Identify Community Assets
3. Analyze Risks
4. Summarize Vulnerability

The geographic area examined for this plan includes the city limits of the cities of Thornton, Federal Heights, and Northglenn, along with identified growth areas for those cities, as well as city-owned lands in Larimer and Weld Counties. Table 4-1 summarizes the overall significance of each hazard of interest based on the results of the risk assessment. The HMPC ranked all the hazards identified above based on their likely geographic extent, expected magnitude/severity, and the probability of future occurrence. An overall significance ranking of high, medium, or low was then assigned to each hazard based on the combination of those factors. Public concern was also considered based on results from the public survey and public review of the draft Plan.

Table 4-1 Hazards Summary

Hazard	Federal Heights	Northglenn	Thornton
Cyber Attack	Medium	Medium	Medium
Dam Failure	Low	Low	Medium
Drought & Excessive Heat	Medium	Medium	Medium
Earthquake	Low	Low	Low
Expansive Soils	Low	Low	Medium
Flood	High	High	High
Ground & Surface Water Supply Contamination	Medium	Medium	Medium
Hazardous Materials	Medium	Medium	Medium
Mass Transportation Incident	Medium	Medium	Medium
Public Health Hazards	High	High	High
Severe Cold Weather Storms	High	High	High
Severe Warm Weather Storms	Medium	Medium	Medium
Terrorism & Active Shooters	Medium	Medium	Medium
Tornadoes & Microbursts	Medium	Medium	Medium
Wildland Fire	Low	Medium	Medium

Location/Spatial Extent
Extensive: 50-100% of planning area
Significant: 10-50% of planning area
Limited: Less than 10% of planning area

Potential Severity
Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged
Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged
Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.

Potential of Future Occurrence
Highly Likely: Near 100% probability each year.
Likely: Between 10 and 100% probability per year or at least one chance in ten years.
Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Significance
(Based on the preceding three factors)
High: widespread potential impact
Medium: moderate potential impact
Low: minimal potential impact

4.1 Hazard Identification

The cities of Thornton, Federal Heights, and Northglenn are vulnerable to a wide range of natural hazards that threaten life, property, and environment. These hazards are addressed individually in local and regional emergency management plans. The hazards identified by the planning team for inclusion in the plan are those determined to be a potential threat to residents, businesses, visitors, and commuters.

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

For comparison, Table 4-2 compares the hazards that were profiled in the 2018 State of Colorado Hazard Mitigation Plan; the 2017 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan; the 2020 Adams County Hazard Mitigation Plan, and the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan.

Table 4-2 State/Region/County Plan Hazards Matrix

Hazards in the 2018 State of Colorado Hazard Mitigation Plan	Hazards in the 2017 Thornton, Federal Heights, Northglenn Hazard Mitigation Plan	Hazards in the 2020 Adams County Hazard Mitigation Plan	Hazards in the 2023 Thornton, Federal Heights, Northglenn Hazard Mitigation Plan
Animal Disease Outbreak			
Avalanche			
CBRN Attacks			
Critical Infrastructure Disruption/Failure			Mass Transportation Incident
Cyber Attack		Cyber Incident	Cyber Attack
Dam/Levee Failure		Dam Failure/Incident	Dam Failure
Dense Fog			
Drought	Drought	Drought	Drought & Excessive Heat
Earthquake	Earthquake	Earthquake	Earthquake
Erosion and Deposition			
Expansive Soils and Heaving Bedrock	Expansive Soils / Undermined Areas		Expansive Soils
Explosive Attack		Terrorism/Active Shooter	Terrorism & Active Shooters
Extreme Heat	Extreme Temperatures		Drought & Excessive Heat
Flood	Flood – Flash and Riverine	Flood	Flood
Hail			
Hazardous Materials Release		Hazardous Materials Incident	Hazardous Materials
Landslide/Mud/Debris Flows/Rock Fall/Rockslide			
Mine Accident			
Pandemic	Public Health Hazards		Public Health Hazards
Pest Infestation			
Power Failure			
Radiological Release			
Radon/Carbon Monoxide/Methane/Other Seeps			
Severe Wind			
Severe Winter Weather	Winter Storm	Winter Weather	Severe Cold Weather Storms

Hazards in the 2018 State of Colorado Hazard Mitigation Plan	Hazards in the 2017 Thornton, Federal Heights, Northglenn Hazard Mitigation Plan	Hazards in the 2020 Adams County Hazard Mitigation Plan	Hazards in the 2023 Thornton, Federal Heights, Northglenn Hazard Mitigation Plan
Sinkholes/Subsidence	Expansive Soils / Undermined Areas	Subsidence	Expansive Soils / Undermined Areas
Telecommunications Failure			
Thunderstorms and Lightning	Severe Storm (Hail, Lightning)	Thunderstorms	Severe Warm Weather Storms
Tornado	Tornado and Severe Wind	Tornado/Damaging Wind	Tornadoes & Microbursts
Wildfire	Wildland Fire	Wildfire	Wildland Fire
Wildlife Vehicle Collisions			
			Ground & Surface Water Supply Contamination

Clearly, many of these hazards are interconnected (for example, severe storms can cause flooding and prolonged drought can lead to wildland fire). Therefore, discussion of these hazards overlaps throughout the Risk Assessment.

4.1.1 Data Sources

Historical data, catastrophic potential, relevance to the jurisdiction, and the probability and potential magnitude of future occurrences were all used to identify and prioritize the list of hazards most relevant to the planning area. Hazard data was obtained from various federal, state, and local sources to include:

- Colorado State Forest Service (CSFS) Colorado Forest Atlas
- Colorado Geological Survey (CGS)
- Colorado Dam Safety Division
- FEMA
- NOAA National Center for Environmental Information (NCEI)
- US Environmental Protection Agency (EPA)
- Federal Bureau of Investigation (FBI)
- United States Geological Survey (USGS)
- State and county Hazard Mitigation Plans
- Subject-matter experts among the HMPC and city agency-level data collection
- Local and national news reports

Together, these sources were examined to assess the significance of these hazards to the planning area. See Appendix E for a complete listing of sources and references.

4.1.2 Disaster Declaration History

One method used to identify hazards was to examine events that triggered federal and/or state disaster declarations. Federal and/or state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the USDA, and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

A USDA disaster declaration certifies that the affected county has suffered at least a 30% loss in one or more crop or livestock areas and provides affected producers with access to low-interest loans and other programs to help mitigate the impact of the disaster. In accordance with the Consolidated Farm and Rural Development Act, all

counties neighboring those receiving disaster declarations are named as contiguous disaster counties and, as such, are eligible for the same assistance.

Table 4-3 lists state and federal disaster declarations received by Adams County. Many of the disaster events were regional or statewide but are presumed to have impacted the planning area. Note that for events that received both federal and state declarations, only the federal disaster is listed to avoid duplication. In all, Adams County has experienced 39 events since 1965 that led to disaster or emergency declarations, including 10 Presidential, 12 USDA, and 17 State declaration.

Table 4-3 Disaster Declaration History in Adams County, 1953-Present

Year	Hazard	Declaration Type	Disaster No.
1965	Tornadoes, severe storms & flooding	Presidential Disaster	DR-200
1969	Heavy rains, snowmelt, and flooding	Presidential Disaster	DR-261
1973	Dam failure	Presidential Disaster	DR-385
1981	Tornadoes	State Declaration	
1982	Severe winter storm	State Declaration	
1982	Dam safety	State Declaration	
2000	Drought	USDA Disaster	
2001	Severe winter storms	State Declaration	
2002	Wildfires	Presidential Disaster	DR-1421
2002	Wildfires	State Declaration	
2002	Drought	USDA Disaster	
2002	Drought	State Declaration	
2003	Snow	Presidential Emergency	EM-3185
2003	Snow emergency	State Declaration	
2005	Hurricane Katrina Evacuation	Presidential Emergency	EM-3224
2006	Drought, fire, heat, and high winds	USDA Disaster	
2006	Snow	Presidential Emergency	EM-3270
2009	Severe blizzard	State Declaration	
2009	Severe spring snowstorm	State Declaration	
2012	Hail, high winds, and flash flooding	USDA Disaster	S3347
2012	Drought, excessive heat, high winds	USDA Disaster	S3260
2013	Flooding	Presidential Emergency Presidential Disaster	EM-3365 DR-4145
2013	Drought	USDA Disaster	S3548
2013	Drought	USDA Disaster	S3456
2013	Winter storm	State Declaration	
2014	Extreme weather	State Declaration	
2015	Severe storms, tornadoes, flooding, landslides, and mudslides	Presidential Disaster	DR-4229
2016	Blizzard	State Declaration	
2017	Wildfire	State Declaration	D 2017-017
2017	Drought	USDA Disaster	S4145
2018	Hail, high winds, rain, and tornadoes	USDA Disaster	S4404
2018	Cybersecurity	State Declaration	D 2018-001
2020	Covid-19 Pandemic	Presidential Emergency Presidential Disaster	EM-3436 DR-4498

Year	Hazard	Declaration Type	Disaster No.
2020	Drought	USDA Disaster	S4742, S4798, S4848
2020	Multiple Fires Statewide	State Declaration	D 2020-194
2021	Drought	USDA Disaster	S4917
2021	Potential Civil Unrest	State Declaration	D 2021-019
2021	Severe Winter Weather	State Declaration	D 2021-064
2022	Drought	USDA Disaster	S5147

Source: fema.gov; usda.gov; State of Colorado Hazard Mitigation Plan 2018; Colorado Governor Executive Orders 2014-2019

Out of 39 declared disasters, eleven have been for drought, ten have been for winter weather, and eight have been for severe spring/summer storms and flooding. The most damaging disaster in Colorado's history was the severe flooding in 2013 (EM-336 & DR-4145), which led to over $26M in Public Assistance funds in the state.

4.1.3 Identified Hazards

While the 2017 Plan only addressed natural hazards, the HMPC identified several human-caused hazards with potential to cause damage, losses, or casualties to the three cities, and elected to incorporate those hazards into the 2023 update.

Based on the above information, the HMPC identified the following hazards as being of significant enough concern to warrant further profiling:

- Cyber Attack
- Dam Failure
- Drought & Excessive Heat
- Earthquake
- Expansive Soils
- Flood
- Ground & Surface Water Supply Contamination
- Hazardous Materials
- Mass Transportation Incident
- Public Health Hazards
- Severe Cold Weather
- Severe Warm Weather Storms
- Terrorism & Active Shooters
- Tornadoes & Microbursts
- Wildland Fire

The HMPC also considered the following hazards from the 2018 State of Colorado Hazard Mitigation Plan, but after discussion determined they did not pose enough of a threat to the planning area to warrant inclusion:

- Animal Disease Outbreak
- Avalanche
- CBRN Attacks
- Critical Infrastructure Disruption/Failure
- Dense Fog
- Erosion and Deposition
- Explosive Attack
- Landslide/Mud Flows/Rock Fall
- Mine Accident
- Pest Infestation
- Power Failure
- Radiological Release
- Radon/Carbon Monoxide/Methane/
- Sinkholes/Subsidence
- Telecommunications Failure
- Wildlife Vehicle Collisions

4.1.4 Climate Change

This Plan includes considerations of how changing climate conditions may impact the frequency, intensity, and distribution of specific hazards in the planning area. This analysis builds on that conducted for the 2017 Plan. Because many impacts of climate-induced hazards cross city and county boundaries, some of the discussion looks at impacts on a regional scale. As climate science evolves, future mitigation plan updates may consider including climate change projections in the risk rankings and vulnerability assessments of the hazards included in the Plan.

Anthropogenic climate change is the human induced climatic changes directly linked to the burning of fossil fuels, release of aerosols, and alterations in land use such as industrialized agriculture, urban sprawl, and deforestation. The industrial revolution brought about massive human caused increases in the emission of greenhouse gases, most notably: carbon dioxide. According to NASA, since the mid-20th century levels of atmospheric carbon dioxide have

skyrocketed to levels never seen naturally over the last 400,000 years. This increase has been driven by human activities.

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

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

In 2018, the US Global Change Research Program released the Fourth National Climate Assessment (NCA4), the authoritative and comprehensive report on climate change and its impacts in the United States. Not only did the report confirm that climate change continues to affect Americans in every region of the US, but the report also identifies increased heat, drought, insect outbreaks, wildland fire, and flooding as key climate-related concerns for the Southwest region of the US, which includes Colorado. The following is a summary of climate change impacts from the Fourth National Climate Assessment:

> "*Recent warming in the southwest region is among the most rapid in the nation and is significantly greater than the global average, and the period since 1950 has been hotter than any comparable long period in at least 600 years. Summer temperatures across the state are expected to warm more than winter temperatures and projections suggest that typical summer months will be as warm as (or warmer than) the hottest 10% of summers that occurred between 1950 and 1999. Under the higher emissions scenario (RCP8.5) climate models predict an increase of 8.6°F in the southwest regional annual average temperature by 2100.*"

Temperature increases in the southwest region of the United States are also projected to increase probabilities of natural events such as wildland fires, drought, and extreme precipitation. These temperature changes have great potential to directly affect public health through increased risk of heat illnesses, which may be illustrated by severe dehydration, heat exhaustion, and heat stroke. Severe temperatures can also directly affect critical infrastructure through increased risk of disruptions of electric power generation. Power lines and power generation systems can be less efficient in production and transportation of energy during high temperatures, combined with a spike in demand for power supply to fuel air conditioning/heating, ventilation, and air conditioning (HVAC) systems and other household electronics as people stay inside to cool down.

Water supplies are also vulnerable to impacts of higher temperatures. While water supplies generally change year-to-year due to variabilities in water use and precipitation, higher temperatures are projected to increase evapotranspiration, reducing the effectiveness of precipitation in replenishing surface water and soil moisture. This will have direct impacts on water availability for domestic use, as well as on crop yields and productivity of key regional crops and livestock, a major risk for the agricultural industry and food security nationwide. It may also impact the availability of freshwater supplies for communities. Finally, growing seasons may also lengthen due to slowed crop growth, causing disruption to the ecosystem such as depleted soil moisture, affecting surface water streamflow and groundwater recharge.

The impacts of climate-exacerbated hazards pose a threat to people and property, particularly those who are low-income, children, elderly, people with chronic health conditions, individuals with disabilities or others with access and functional needs, persons experiencing homelessness, and minorities who are disproportionately impacted by the effects of hazards. Refer to Section 3.8 for more information on social vulnerability.

In the context of mitigation planning, climate change also adds a unique variable in the overall assessment of risk. Historically, one of the major indicators for future risk has been based on an assessment of the severity and frequency of previous events. As climate change begins to alter the climatic forces which drive some of these hazards, there is uncertainty introduced concerning how the future frequency of events will change in coming years. This is discussed for each hazard more specifically within the hazard profile using the best available science. Together, climate change impacts represent a slow-onset disaster that is likely to manifest and change over time. Current projections predict even more rapid changes in the near future, which are likely to affect many of the natural hazards the planning area has historically experienced.

Information on the possible impacts of climate change on specific hazards is included in each hazard profile below.

4.1.5 Hazard Profiling

The hazard profiles in Section 4.4 consist of the following elements:

- **Description:** A general overview of the hazard being considered.
- **Previous Occurrences:** Overview history of the hazard's occurrences, compiled from multiple data sources, to include information provided by the planning team and the public. Significant incidents are profiled in greater detail and include scope, severity, and magnitude, and known impacts.
- **Location/Extent:** Discusses what parts of the planning area are most likely to be affected by the hazard.
- **Magnitude/Severity:** Summarizes the anticipated magnitude and severity of a hazard event based largely on previous occurrences and specific aspects of the planning area. It also factors in speed of onset and duration. Calculated and assessed using the event of record, which represents an anticipated worst-case scenario or common occurrence.
- **Probability of Future Occurrence:** Estimates the likelihood or probability of future occurrences of the hazard. Note that while the frequency of natural hazards can generally be estimated based on past data and best available science, estimating the frequency of many human-caused hazards is much more speculative due to the generally smaller number of incidents and uncertainty around attacker capabilities and intensions.
- **Climate Change Considerations:** Discusses how the projected impacts of climate change may affect the likelihood and severity of the hazard in the future.
- **Vulnerability Assessment:** Analysis of potential impacts on the following categories: people, economy, built environment and general property (including critical infrastructure), historical, cultural, and natural environment, future land use and development (how projected trends in land use, and development have the potential to increase or decrease the impact of the hazard).
- **Risk Summary:** Summarizes the key consequences of the hazard and its impact on the community.

Based on a combination of the above factors, an overall hazard significance was assigned to each hazard for each jurisdiction, as summarized in Table 4-1. Specifics on how the characteristics of each hazard may differ among the three jurisdictions can be found in the municipal annexes.

4.2 Assets at Risk

This section identifies and inventories community assets that could potentially be impacted by hazard events.

4.2.1 People

The 2020 Census populations of the three cities are listed in Table 4-4. To estimate the number of people in identified hazard areas, the number of residential parcels at risk were multiplied by the Census Bureau's average household size for each jurisdiction, which is also shown in Table 4-4. For more demographic information refer to Section 2 Community Profile.

Table 4-4 Population and Average Household Size by Jurisdiction

Jurisdiction	Population	Average Household Size
Federal Heights	15,537	3.14
Northglenn	39,201	2.89
Thornton	144,186	3.07
Total	**198,924**	**NA**

Source: U.S. Census Bureau

4.2.2 General Property

General property exposure to hazards is based on Federal Heights, Northglenn and Thornton parcel data containing assessor information such as total number of parcels, improvement values, and parcel types by jurisdiction. Only those parcels with improvement values greater than $0, were used for analysis; non-developed or non-improved parcels were excluded for the purposes of conducting the vulnerability assessment.

Counts and values are based on the latest County assessor's data (as of January 2021), which was provided in GIS and tabular (spreadsheet) formats. Improvement values and parcel type attributes were joined to the parcel geometries in GIS, to enable spatial analysis and mapping. Building footprints were used where available to determine whether or not a building falls within a hazard area. For parcels without buildings, parcel centroids where used. Values for building contents were estimated as a percent of the improvement value based on parcel type using standard FEMA Hazus values: 50% of the improvement value for residential structures (including mobile homes), 150% for industrial and 100% for the other property types. Finally, total values were aggregated by adding the improvement and content values for parcels in each jurisdiction.

Table 4-5 through Table 4-7 break down property exposure by parcel type. Parcels are categorized as follows:

- **Agricultural:** Property devoted to raising crops and/or livestock for production of food.
- **Commercial:** Property used for business activities; can also refer to land used to generate a profit, as well as large residential rental properties.
- **Exempt:** Government-owned property exempt from local taxes.
- **Industrial:** Property used to develop, manufacture, or produce goods and products, or the movement and storage of products and goods.
- **Residential:** Property zoned for living or dwelling of individuals and households, from stand-alone single-family dwellings to large, multi-unit apartment buildings.

The following tables shows that Federal Heights has 3,620 buildings with a combined value of $1.3 billion; Northglenn has 11,796 buildings with a combined value of $6.5 billion; while Thornton has 44,124 buildings worth $23.7 billion within the city limits and another 4,054 buildings worth $1.5 billion in the growth area and city-owned properties outside the city limits. In total the planning area contains 63,594 buildings with a combined value of $33 billion. 97% of the parcels in the planning area are classed as residential (including mobile homes).

Table 4-5 Federal Heights Total Exposure by Property Type

Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Commercial	94	175	$89,338,071	$89,338,071	$178,676,142
Exempt	30	80	$29,172,418	$29,172,418	$58,344,836
Industrial	1	1	$6,293,003	$9,439,505	$15,732,508
Mobile Home	10	2,025	$122,380,952	$61,190,476	$183,571,428
Residential	1,177	1,339	$589,514,002	$294,757,001	$884,271,003
Total	**1,312**	**3,620**	**$836,698,446**	**$483,897,471**	**$1,320,595,917**

Source: Wood Analysis of Assessor's Data

Table 4-6 Northglenn Total Exposure by Property Type

Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Agricultural	61	114	$18,449,315	$18,449,315	$36,898,630
Commercial	273	388	$296,391,604	$296,391,604	$592,783,208
Exempt	88	156	$244,673,868	$244,673,868	$489,347,736
Industrial	15	21	$38,120,070	$57,180,105	$95,300,175
Residential	9,858	11,117	$3,507,342,493	$1,753,671,247	$5,261,013,740
Total	**10,295**	**11,796**	**$4,104,977,350**	**$2,370,366,139**	**$6,475,343,489**

Source: Wood Analysis of Assessor's Data

Table 4-7 Thornton Total Exposure by Property Type and Location

Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Agricultural	11	37	$3,486,214	$3,486,214	$6,972,428
Commercial	541	900	$928,634,543	$928,634,543	$1,857,269,086
Exempt	159	358	$819,829,281	$819,829,281	$1,639,658,562
Industrial	2	2	$9,716,789	$14,575,184	$24,291,973
Mobile Home	7	3,149	$105,076,952	$52,538,476	$157,615,428
Residential	38,770	39,678	$13,321,056,978	$6,660,528,489	$19,981,585,467
Total	**39,490**	**44,124**	**$15,187,800,757**	**$8,479,592,187**	**$23,667,392,944**
Total Exposure by Property Type for Thornton Property (Growth Areas Only)					
Agricultural	51	162	$17,366,860	$17,366,860	$34,733,720
Commercial	5	10	$240,486	$240,486	$480,972
Exempt	19	62	$33,660,703	$33,660,703	$67,321,406
Residential	2,887	3,649	$926,161,061	$463,080,531	$1,389,241,592
Total	**2,962**	**3,883**	**$977,429,110**	**$514,348,580**	**$1,491,777,690**
Total Exposure by Property Type for Thornton Properties outside of City Limits					
Exempt (Larimer)	13	13	$970,268	$970,268	$1,940,536
Exempt (Weld)	158	158	$13,333,436	$13,333,436	$26,666,872
Total	**171**	**171**	**$14,303,704**	**$14,303,704**	**$28,607,408**
GRAND TOTAL	**42,623**	**48,178**	**$16,179,533,571**	**$9,008,244,470**	**$25,187,778,041**

Source: Wood Analysis of Assessor's Data

4.2.3 Critical Facilities and Infrastructure

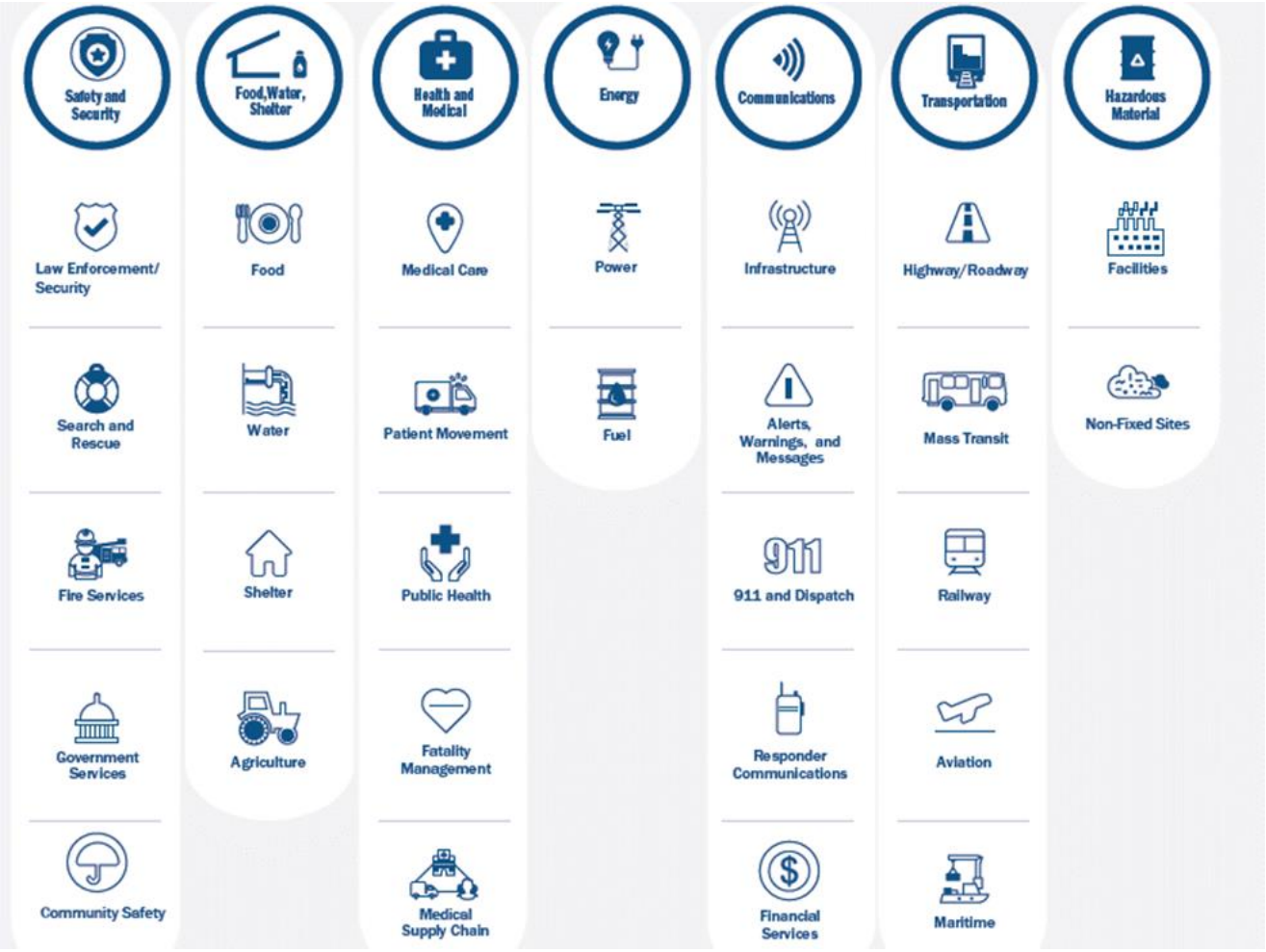
A critical facility is one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. Figure 4-1 depicts the Lifeline categories, which are FEMA's recommended way of classifying critical facilities and infrastructure. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security.

Many critical facilities are publicly owned. Publicly owned facilities are a key component of daily life for all citizens of the city. Public buildings are of particular importance during flood events because they house critical assets for government response and recovery activities. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Loss of power and communications can be expected. Drinking water and wastewater treatment facilities may be temporarily out of operation.

Flooding can have various impacts to responders in terms of response time and the personal safety of first responders. Flooded roadways are a common occurrence in the planning area and can block emergency vehicles from crossing certain areas, delaying response times.

Public confidence may be hindered if warnings and alerts prior to the flood event are not communicated effectively. The government's ability to respond and recover may be questioned and challenged by the public if planning, response, and recovery is not timely and effective, particularly in areas that have repeated flooding.

Figure 4-1 Lifeline Categories



Source: FEMA

To develop a comprehensive list of critical facilities in Thornton, Federal Heights and Northglenn, several data sources were compiled including GIS databases of critical facilities and infrastructure from these areas. This data was then reviewed and fact-checked by the Planning Team to ensure accuracy. These facilities are summarized below by jurisdiction in Table 4-8 through Table 4-10. A map of these facilities can be found in Appendix H (not for public release).

Federal Heights has a total of 29 critical facilities, 15 of which are communications towers.

Table 4-8 Federal Heights Critical Facilities by Type and Jurisdiction

FEMA Lifeline	Critical Facility Type	Count
Communications	Land Mobile Private Tower	10
	Microwave Towers	4
	Paging Tower	1
	Total	**15**
Energy	Electric Substations	1
	Total	**1**
Food, Water, Shelter	EO Emergency Shelters	2
	Total	**2**
Hazardous Material	Environmental Hazard Superfund	1
	Tier II Facility	2
	Total	**3**
Health and Medical	Adult Day Care	1
	Assisted Living	1
	Total	**2**
Safety and Security	Fire Stations	1
	Police Station	1
	School	4
	Total	**6**
	Grand Total	**29**

Source: Wood Analysis of Federal Heights and HIFLD data

Northglenn has 122 critical facilities, 49 of which are communications towers, 22 of which are schools, and 19 of which are healthcare facilities.

Table 4-9 Northglenn Critical Facilities by Type and Jurisdiction

FEMA Lifeline	Critical Facility Type	Count
Communications	Land Mobile Private Tower	23
	Microwave Towers	26
	Total	**49**
Energy	Electric Substations	2
	Total	**2**
Food, Water, Shelter	EO Emergency Shelters	5
	Wastewater Treatment Plant	1
	Water Treatment Plant	1
	Total	**7**
Hazardous Material	Environmental Hazard Toxic Site	1
	Tier II Facility	5
	Total	**6**
Health and Medical	Adult Day Care	1
	Assisted Living	9
	Clinic	1
	Disability Care	1
	Home and Community Based Services	4
	Hospice	1
	Nursing Home	1
	Surgery or Transplant	1
	Total	**19**
Safety and Security	Fire Stations	2
	Fire Training Center	1
	Landfills/Govt. Services	3

FEMA Lifeline	Critical Facility Type	Count
	Police Station	1
	School	22
	Total	**29**
Transportation	Non-Scour Fair Condition Bridge	6
	Non-Scour Good Condition Bridge	4
	Total	**10**
	Grand Total	**122**

Source: Wood Analysis of Northglenn and HIFLD data

Thornton has 391 critical facilities within its city limits, including 102 communications towers, 53 bridges, 51 healthcare facilities, 43 schools, and 49 hazardous materials sites. Thornton's growth areas contain an additional 97 facilities, including 22 communications towers and 33 hazardous materials sites.

Table 4-10 Thornton Critical Facilities by Type and Jurisdiction

FEMA Lifeline	Critical Facility Type	Thornton City Count	Thornton Growth Areas Count
Communications	Cell Tower	1	-
	Communication Towers	2	8
	Land Mobile Private Tower	68	8
	Microwave Towers	31	6
	Total	**102**	**22**
Energy	Electric Substations	3	2
	Power Plant	-	1
	Total	**3**	**3**
Food, Water, Shelter	EO Emergency Shelters	5	1
	Gravel Mines/Ponds	8	7
	Grocery	13	-
	Pump Station	1	-
	Water Tower	6	-
	Water Treatment Plant	3	-
	Total	**36**	**8**
Hazardous Material	Environmental Hazard Toxic Site	-	-
	Tier II Facility	49	33
	Total	**49**	**33**
Health and Medical	Assisted Living	11	-
	Birth Center	1	-
	Dialysis Center	2	-
	Federally Qualified Health Center	1	-
	Home and Community Based Services	9	-
	Hospice	1	-
	Hospital	3	-
	Hospital/Surgical Center	3	-
	Medical Center	1	-
	Mental Health Center	1	-
	Nursing Home	6	-
	Rehabilitation or Recovery	2	-
	Senior Housing	8	-
	Surgery or Transplant	1	-
	Urgent Care	1	-
	Total	**51**	-
Safety and Security	Community Center	5	-

FEMA Lifeline	Critical Facility Type	Thornton City Count	Thornton Growth Areas Count
	Daycare	26	-
	Fire / Police Station	1	-
	Fire Stations	5	-
	Government Facilities	1	11
	Higher Education	2	-
	Landfills/Govt. Services	5	4
	Library	2	-
	Non-Profit	4	-
	Police Station	1	-
	Preschool	2	-
	School	43	2
	Total	**97**	**17**
Transportation	Non-Scour Bridge, Good Condition	31	6
	Non-Scour Bridge, Fair Condition	19	8
	Non-Scour Bridge, Poor Condition	3	-
	Total	**53**	**14**
	Grand Total	**391**	**97**

Source: Wood Analysis of Thornton (Incorporated and Unincorporated Areas) and HIFLD data

4.2.4 Historic, Cultural and Natural Resources

Assessing the vulnerability of Thornton, Federal Heights and Northglenn communities to disasters also involves inventorying the natural, historic, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules and laws for reconstruction, restoration, rehabilitation, and/or replacement are often specific for these types of designated resources (e.g., under the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act).
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

Historic and Cultural Resources

A historic property not only includes buildings or other types of structures such as bridges and dams but can also refer to prehistoric or Native American sites, roads, byways, historic landscapes, and such other features. Historic properties and cultural resources are also valuable economic assets that increase property values and attract businesses and tourists. Far from being at odds with economic development, preservation of these assets is often an important catalyst for economic development (e.g., historic downtown revitalization programs leading to growth in heritage tourism).

Information on historic assets and properties in the planning area was obtained from the National Register of Historic Places (NRHP). The NRHP database, administered by the National Park Service, is the Nation's official list of cultural resources worthy of preservation, and the NRHP overall is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archaeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. There are three HRHP-historic properties in the planning area, two in Northglenn and one in Thornton, as summarized in Table 4-11.

Table 4-11 Historic and Cultural Properties

Historic Place Name	Location	Year Listed	Data Source
Thede Farmhouse	Northglenn	1998	NRHP
St. Stephen's Lutheran Church	Northglenn	2019	NRHP
Eastlake Farmers' Co-Operative Elevator Co.	Thornton	2010	NRHP

Source: National Park Service National Register of Historic Places

The Colorado State Register of Historic Properties lists additional resources that the State has deemed to be worthy of preservation for the future education and enjoyment of Colorado's residents and visitors. The State Register does not list any additional sites in the planning area.

It should be noted that as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Natural Resources

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetland areas can protect sensitive habitat as well as attenuate and store floodwaters.

Wetlands are a valuable natural resource for communities due to their benefits to water quality, wildlife and habitat protection, recreation, and education, and play an important role in hazard mitigation. Wetlands provide natural floodplain protection by reducing flood peaks and slowly releasing floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. They also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation is vital.

Endangered Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at risk species (endangered and threatened species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are a third category of plants and animals at risk, but these have been proposed as endangered or threatened but are not currently listed.

The US Fish and Wildlife Service (USFW) Environmental Conservation Online System (ECOS) lists 22 federally endangered, threatened, or candidate/proposed/other status review species in Adams County as of March 2022. These are listed in Table 4-12 below. Resolved Taxon refers to species for which a Not Warranted 12 month finding or Not Substantial 90-day finding has been published in the Federal Register, or which has been removed from the candidate list.

Table 4-12 Endangered Species Thornton, Federal Heights, and Northglenn

Group	Common Name	Scientific Name	Status
Birds	Whooping crane	*Grus americana*	Experimental Population
Mammals	Tricolored bat	*Perimyotis subflavus*	Under Review

Group	Common Name	Scientific Name	Status
Insects	Monarch butterfly	*Danaus plexippus*	Candidate
Mammals	Little brown bat	*Myotis lucifugus*	Under Review
Insects	Regal fritillary	*Speyeria idalia*	Under Review
Mammals	Long-eared myotis	*Myotis evotis*	Species of Concern
Birds	Ferruginous hawk	*Buteo regalis*	Resolved Taxon
Flowering Plants	Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened
Amphibians	Northern leopard frog	*Rana pipiens*	Resolved Taxon
Birds	Western burrowing owl	*Athene cunicularia ssp. hypugaea*	Species of Concern
Birds	White-faced ibis	*Plegadis chihi*	Species of Concern
Mammals	Long-legged myotis	*Myotis volans*	Species of Concern
Birds	Bald eagle	*Haliaeetus leucocephalus*	Recovery
Mammals	Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Threatened
Birds	Swainson's hawk	*Buteo swainsoni*	Resolved Taxon
Birds	Mountain plover	*Charadrius montanus*	Resolved Taxon
Flowering Plants	Western prairie fringed Orchid	*Platanthera praeclara*	Threatened
Reptiles	Eastern short-horned lizard	*Phrynosoma douglassii brevirostra*	Species of Concern
Mammals	Swift fox	*Vulpes velox*	Resolved Taxon
Birds	American peregrine falcon	*Falco peregrinus anatum*	Recovery
Mammals	Black-footed ferret	*Mustela nigripes*	Endangered
Mammals	Black-tailed prairie dog	*Cynomys ludovicianus*	Resolved Taxon

Source: US Fish & Wildlife Service ECOS

4.3 Cyber Attack

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Significant	Limited	Likely	**Medium**
Northglenn	Significant	Limited	Likely	**Medium**
Thornton	Significant	Limited	Likely	**Medium**

4.3.1 Description

The US Department of Homeland Security's National Cyber Incident Response Plan defines cyber incidents as:

- **Cyber Incident:** An event occurring on or conducted through a computer network that actually or imminently jeopardizes the confidentiality, integrity, or availability of computers, information or communications systems or networks, physical or virtual infrastructure controlled by computers or information systems, or information resident thereon.
- **Significant Cyber Incident:** A cyber incident that is (or group of related cyber incidents that together are) likely to result in demonstrable harm to the national security interests, foreign relations, or economy of the United States or to the public confidence, civil liberties, or public health and safety of the American people.

While cyber incidents are not always intentional, this hazard profile focuses on incidents caused by malicious actors. This can include both cyber criminals that are looking to steal data for financial gain, as well as cyber terrorists that are seeking to destroy or undermine systems for political or organizational reasons. For purposes of this profile, both are collectively referred to as cyber attacks.

Cyber attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that, "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks. Cyber threats can take many forms, including:

- **Distributed Denial of Service (DDoS) attack:** Perhaps the most common type of cyber attack, a DDoS attack seeks to overwhelm a network and causes it to either be inaccessible or shut down. A DDoS typically uses other infected systems and internet connected devices to "request" information from a specific network or server that is not configured or powerful enough to handle the traffic.
- **Data breach:** Hackers gaining access to large amounts of personal, sensitive, or confidential information has become increasingly common in recent years. In addition to networked systems, data breaches can occur due to the mishandling of external drives.
- **Phishing attacks:** Phishing attacks are fraudulent communications that appear to come from legitimate sources. Phishing attacks typically come through email but may come through text messages as well. Phishing may also be considered a type of social engineering meant to exploit employees into paying fake invoices, providing passwords, or sending sensitive information.
- **Malware attacks:** Malware is malicious code that may infect a computer system. Malware typically gains a foothold when a user visits an unsafe site, downloads untrusted software, or may be downloaded in conjunction with a phishing attack. Malware can remain undetected for years and spread across an entire network.
- **Ransomware:** Ransomware typically blocks access to a jurisdiction's/agency's/ business' data by encrypting it. Perpetrators will ask for a ransom to provide the security key and decrypt the data, although many ransomware victims never get their data back even after paying the ransom.
- **Critical Infrastructure/SCADA System attack:** There have been recent critical infrastructure Supervisory Control and Data Acquisition (SCADA) system attacks aimed at disabling or disrupting critical infrastructure assets such as power plants and wastewater facilities. These attacks typically combine a form of phishing, malware, or other social engineering mechanisms to gain access to the system.

Two related terms that can be used to further the above attacks:

- **Unpatched software exploitation:** Unpatched vulnerabilities allow attackers to run a malicious code by leveraging a known security bug that has not been patched. In a 2019 study by the Ponemon Institute, 60% of breach victims admitted they could have prevented their attacks just by patching known vulnerabilities.
- **Advanced persistent threats:** Advanced persistent threat describes when a stealthy threat actor gains unauthorized access to a computer network and remains undetected for weeks or even months. These types of sophisticated attacks are most often associated with nation states or state-sponsored groups. Cyber security efforts typically focus more on prevention and protection, rather than mitigation per se. However, these terms have considerable overlap in the field of cyber security and are often used interchangeably.

4.3.2 Previous Occurrences

The cybersecurity firm Symantec reports there were a total of 1,209 data breaches worldwide in 2016. While the number of breaches has remained relatively steady, the average number of identities stolen has increased to almost one million per incident. The report also found that one in every 131 emails contained malware, and the company's software blocked an average of 229,000 web attacks every day.

The Privacy Rights Clearinghouse, a nonprofit organization based in San Diego, maintains a timeline of 9,015 data breach incidents in the United States from 2005-2021. The database lists 47 data breaches resulting from hacking incidents against systems located in Colorado, totaling over 400,000 impacted records. However, it is difficult to know how many of those affected Thornton, Federal Heights, and Northglenn residents. Attacks happening outside of the state can also impact local businesses, personal identifiable information, and credit card information. Table 4-13 shows several of the more significant cyber-attacks in the form of hacking in Colorado in recent years.

Table 4-13 Major Cyber Attacks Impacting Colorado, 2005-2021

Date Reported	Target	Total Records	Description
July, 2005	University of Colorado, Boulder	49,000	Data exposure/ personal identifiable information
August, 2005	University of Colorado, Denver	36,000	Data exposure/ personal identifiable information
July, 2007	Western Union, Greenwood Village	20,000	Credit card breach
November 2013	Denver SAN	Unknown	Ransomware
April, 2014	Centura Health, Englewood	12,286	Health information breach
July, 2017	PVHS-ICM Employee Health and Wellness, Fort Collins	10,143	Data exposure/health information
February, 2018	Colorado Department of Transportation (CDOT)	N/A	Data encryption/ ransomware
August, 2019	Regis University	N/A	DDoS
December, 2019	Southeast Metro Storm Water Authority (SEMSWA)	N/A	Ransomware
June, 2020	Colorado Information Analysis Center (CIAC)	Unknown	Data Breach
July 2021	City of Lafayette	Unknown	Ransomware

Source: Privacy Rights Clearinghouse

The FBI's 2021 Internet Crime Report states that the FBI received 847,376 complaints in 2021, up from 301,580 in 2017. Total losses in 2021 equaled $6.9 billion, compared to $1.4 billion in 2017. Colorado saw 11,276 incidents and over $140 million in losses. The FBI report notes that government facilities remain popular targets but does not break down how many of those attacks were against government systems.

Looking at ransomware specifically, 2021 saw 3,729 incidents reported, with over $49 million in losses. Colorado saw 55 ransomware incidents totaling $342,000 in losses. Even if a victim is perfectly prepared with full offline data

backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom. However, according to a 2016 study by Kaspersky Lab, roughly one in five ransomware victims who pay their attackers never recover their data.

Recent years have seen an increase in ransomware attacks, particularly against local government systems. For example:

- The City of Atlanta was hit by a major ransomware attack in 2018, recovery from which wound up costing a reported $2.6 million, significantly more than the $52,000 ransom demand.
- A similar attack against the City of Baltimore in 2019 affected the City government's email, voicemail, property tax portal, water bill, and parking ticket payment systems, and delayed more than 1,000 pending home sales.
- In March 2019, Orange County, North Carolina was attacked with a ransomware virus, causing slowdowns and service problems at key public offices such as the Register of Deeds, the Sheriff's Office, and county libraries. The attack impacted a variety of county services, including disrupting Denver's capability to process real estate closings, issue marriage licenses, process fees or permits, process housing vouchers, and verify tax bills.

Sophisticated cyber attacks against critical infrastructure are less common, but there have been several notable examples in recent years:

- In February 2018, a large, sophisticated malware attack, known as Olympic Destroyer, was launched against the Winter Olympics in Pyeongchang, South Korea. The attack initially took down servers, email, Wi-Fi, and ticketing systems, which could have severely disrupted the games. Fortunately, the organizing committee had a robust cybersecurity group that was able to quickly restore most functions.
- In February 2021, a cyber attack on a water treatment system in Oldsmar, Florida put thousands at risk of being poisoned. A hacker accessed the system remotely and adjusted the level of sodium hydroxide to more than 100 times its normal levels. Fortunately, an operator noticed the intrusion immediately and was able to reduce the levels back before any significant effects on the city's water supply.
- In December 2015, a cyber attack took down the power grid in Ukraine, leaving over 230,000 people without power. The outage lasted up to six hours for residents, but the computers on-site that were infected could not be salvaged.
- A ransomware attack on the Colonial Pipeline in 2021 caused temporary gas shortages for the East Coast as well as major disruption to air travel in the US News reports claimed the company paid a ransom of nearly $5M to the hackers in exchange for a decryption tool; however, the tool proved so slow that the company's existing tools were more effective in bringing back operational capacity.
- In January and February 2022, coordinated Russian cyber attacks took down several Ukrainian government websites, as well as multiple banking services; most outages were restored within a few hours. On March 21, 2022, President Biden issued a statement warning that "the Russian Government is exploring options for potential cyberattacks" against U.S. critical infrastructure.

4.3.3 Location

Cyber security attacks can and have occurred in every location regardless of geography, demographics, and security posture. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within the city. All servers in the Cities of Thornton, Federal Heights and Northglenn are potentially vulnerable to cyber security attacks. The geographic extent is **significant**.

4.3.4 Magnitude/Severity

There is no universally accepted scale to explain the severity of cyber-attacks. The strength of a DDoS attack is often explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, the October 21, 2016, Dyn attack, peaked at 1.2 terabytes per second and impacted some of the internet's most popular sites, including Amazon, Netflix, PayPal, Twitter, and several news organizations.

Data breaches are often described in terms of the number of records or identities exposed. The largest data breach ever reported occurred in August 2013, when hackers gained access to all three billion Yahoo accounts. The hacking incidents associated with Colorado in the Privacy Rights Clearinghouse database are of a smaller scale, ranging from just 32 records to approximately 60,000, along with several cases in which an indeterminate number of records may have been stolen.

Ransomware attacks are typically described in terms of the amount of ransom requested, or by the amount of time and money spent to recover from the attack. One report from cybersecurity firm Emsisoft estimates the average successful ransomware attack costs $81 million and can take 287 days to recover from.

Infrastructure attacks are typically described in terms of number of people impacted and the duration of the outage. Most attacks to date have seen services restored within a few hours.

The potential magnitude and severity of cyber security attacks is **critical**.

4.3.5 Probability of Future Occurrences

The probability of future cyber attacks in the planning area is **likely**. Small-scale cyber security attacks such as DDoS attacks occur daily, and will almost certainly continue to do so, but most have negligible impacts at the local or regional level. Data breaches are also extremely common, but again most have only minor impacts on government services.

Perhaps of greatest concern to the planning area are ransomware attacks, which are becoming increasingly common as noted above. While all sources agree that ransomware attacks against government assets are a significant and increasing threat, there is no generally agreed on methodology for quantifying the probability of an attack against any specific jurisdiction. Based on the frequency of past events it is reasonable to estimate the likelihood of local government servers in the planning area being hit with a successful ransomware attack in any given year as at least 1 in 10.

The possibility of a larger disruption affecting systems within the three cities is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker.

Finally, there remains the existence of zero-day vulnerabilities which are unknown cyber vulnerabilities or known vulnerabilities without patches – where zero-day attacks, which make up most successful breaches, are vulnerabilities identified by malicious actors before a patch has been developed and implemented. Major attacks specifically targeting systems or infrastructure in the three cities cannot be ruled out.

4.3.6 Climate Change Considerations

There are no known effects of climate-induced impacts on human-caused hazards such as cyber attacks.

4.3.7 Vulnerability Assessment

People

Injuries or fatalities from cyber attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure. More likely impacts to the public are financial losses and an inability to access systems such as public websites and permitting sites. Indirect impacts could include interruptions to traffic control systems or other infrastructure.

Data breaches and subsequent identify thefts can have huge impacts on the public. The Internet Crime Complaint Center (IC3) estimates that identity theft alone resulted in $2.7 billion in losses to businesses and $149 million in losses to individuals.

General Property

Facility management systems such as security systems, HVAC systems, and other technologically connected aspects of general property maintenance may be impacted by cyber incidents or attacks. Generally, cyber incidents or attacks have minimal impact on the actual general property and impact more the services, businesses, or commodities held within the physical general property.

Critical Facilities and Infrastructure

The vast majority of cyber attacks affect only data and computer systems. However, sophisticated attacks have occurred against the SCADA systems of critical infrastructure, which could potentially result in system failures on a scale equal to natural disasters.

Economy

Economic impacts from cyber security attacks can be debilitating. The cyber attack in 2018 that took down the City of Atlanta cost at least $2.5 million in contractor costs and an estimated $9.5 million additional funds to bring everything back online. The attack in Atlanta took more than a third of the 424 software programs offline and recovery lasted more than 6 months. The 2018 cyber attack on the Colorado Department of Transportation (CDOT) cost an estimated $1.5 million. None of these statistics include the economic losses to businesses and ongoing IT configuration to mitigate a future cyber-attack.

Historic, Cultural and Natural Resources

The vast majority of cyber attacks have little to no impact on historic, cultural, or natural resources. A major cyber terrorism attack could potentially impact the environment by triggering a release of hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices. Institutions of higher education, museums/historical centers, and arts/sports venues could be targeted for ransomware attacks or theft of intellectual property.

Land Use and Development

Changes in development have no impact on the threat, vulnerability, and consequences of a cyber security attack. Cyber attacks can and have targeted small and large jurisdictions, multi-billion-dollar companies, small mom-and-pop shops, and individual citizens. The decentralized nature of the internet and data centers means that the cyber threat is shared by all, regardless of new construction and changes in development.

4.3.8 Jurisdictional Differences

The potential impacts and overall significance would be similar for all three cities, but could vary based on cyber security measures taken by each City.

Cyber attacks were not profiled in the 2017 HMP.

4.3.9 Risk Summary

The overall significance of cyber security attacks in the Cities of Thornton, Federal Heights, and Northglenn is **Medium**. Although the possibility of a larger disruption affecting systems within the three cities is difficult to quantify, the possibility of an attack of any scale impacting one or all of the three cities is almost certain.

- There have been 47 data breaches resulting from hacking incidents statewide over a 15-year period, averaging approximately three incidents per year.
- Nationwide the increase in cyber security attacks has been dramatic year over year. As this trend continues it is safe to assume there is a threat to the three cities.
- Injuries and fatalities to people are unlikely, unless in a widescale attack that affected infrastructure and resulted in indirect impacts on communities. People may also be impacted financially.
- The vast majority of attacks do not affect general property, but sophisticated attacks against utilities and infrastructure such as electrical grids have occurred.
- Economic impacts from a cyber attack can be debilitating, sometimes costing local governments millions of dollars.

4.4 Dam Failure/Inundation

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	None	Negligible	Unlikely	**Low**
Northglenn	Limited	Moderate	Unlikely	**Low**
Thornton	Limited	Critical	Unlikely	**Medium**

4.4.1 Description

Dams are constructed for a variety of uses, including to supply water for agriculture and domestic use, allow for flood control, provide hydroelectric power, and serve as recreational areas.

There are generally three types of dams: concrete arch or hydraulic fill, earth-rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously, an earth-rockfill dam fails gradually due to erosion of the breach, and a concrete gravity dam can fail instantaneously or gradually. Instantaneous failures see a rapid building of the flood wave to a peak, followed by gradual decline. Gradual failures build more slowly to a peak and then decline until the reservoir is empty.

Per the Association of State Dam Safety Officials (ASDSO), dam failures will typically occur due to one of five causes:

- Overtopping, where water spills over the top of the dam, which may occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for 34 percent of all dam failures.
- Foundation defects resulting from settlements, slides, slope instability, uplift pressures, and foundation seepage, which account for about 30 percent of all dam failures.
- Cracking caused by movement, including the natural settling of the dam.
- Inadequate maintenance and upkeep.
- Piping, where seepage causes internal erosion of the dam, accounts for 20 percent of all dam failures. Seepage often occurs around hydraulic structures, animal burrows, roots, and cracks in the dam or dam foundation.

Dam inundation may also result from non-failure events, such as controlled releases due to heavy rains. Controlled releases allow water to escape when a reservoir is overfilling and can prevent overtopping and subsequent failure of a dam. When controlled releases are not enough, spillways are designed to allow excess water to exit the reservoir and prevent overtopping. These releases can protect the dam and avoid catastrophic failure but may result in downstream flooding.

The Colorado Division of Water Resources Dam Safety Branch is responsible for reviewing and approving plans and specifications for construction and repair of dams. Regulatory requirements vary between Jurisdictional-size dams and non-Jurisdictional-size dams, as follows:

- Jurisdictional-size dams have a statutory height greater than ten feet to the spillway crest, a reservoir with more than 100 acre-feet of water, or cover more than 20 acres at the high waterline. These dams must be reviewed and approved by the State Engineer before construction.
- Non-Jurisdictional-size dams include all dams smaller than those that meet the criteria above. These dams require a filing of a Notice of Intent to Construct a Non-Jurisdictional Water Impoundment Structure but plans and specifications are not required for construction.

The Colorado Division of Water Resources Dam Safety Branch assigns hazard classification to dams within the State. Hazard classification is determined by analysis of potential consequences from a sunny day failure of the dam. Dams are classified into four categories that identify the potential hazard to life and property:

- **High Hazard Potential**—a dam for which life loss is expected to result from failure of the dam.
- **Significant Hazard Potential**— a dam for which significant damage, but no life loss is expected to result from failure of the dam. Significant damage is defined as damage to structure where people generally live, work or

recreate, including public and private facilities. Significant damage is determined to be damage sufficient to render structures or facilities uninhabitable or inoperable.

- **Low Hazard Potential**—a dam for which neither life loss nor significant damage as defined for a significant hazard dam are expected to result from failure of the dam.
- **No Public Hazard**—A dam for which minimal damage, with no life loss, is expected to result from failure of the dam.

It is important to keep in mind that the hazard classification of a dam is a measure of the consequences if the dam were to fail, not a measure of how likely the dam is to fail.

High and significant hazard dams are required by Colorado regulations to have Emergency Action Plans (EAPs) in place, which provide for the emergency response procedures in the event of a dam emergency. High and significant hazard dams are also required to have inundation maps. Federally owned high hazard dams are also required to have EAPs by federal regulations. Based on the Colorado Dam Safety Database, as of 2021 all high hazard dams in Colorado have EAPs in place.

State dam engineers regularly conducts safety inspections and rates all dams as one of the following:

- **Satisfactory:** The safety inspection indicates no conditions that appear to threaten the safety of the dam, and the dam is expected to perform satisfactorily under all design loading conditions. Most of the required monitoring is being performed.
- **Conditionally Satisfactory:** The safety inspection indicates symptoms of structural distress (seepage, evidence of minor displacements, etc.), which, if conditions worsen, could lead to the failure of the dam. Essential monitoring, inspection, and maintenance must be performed as a requirement for continued full storage in the reservoir.
- **Unsatisfactory:** The safety inspection indicates definite signs of structural distress (excessive seepage, cracks, slides, sinkholes, severe deterioration, etc.), which could lead to the failure of the dam if the reservoir is used to full capacity. The dam is judged unsafe for full storage of water.

Another kind of dam common in Colorado is a **low head dam**. A low head dam is an engineered structure built into and across stream and river channels. Low head dams were historically built for a variety of purposes to support industrial, municipal, and agricultural water usage through the diversion of water from streams. Low head dams have also been built to provide recreational amenities for boating, rafting, and tubing as well as improve aquatic habitats (Colorado DNR). Water flows over the dams creating a recirculating current that can trap unknowing river users. Due to the low height of this type of dam, low head dams can be difficult to see by river users that are not aware of them and because of the tranquil pool that gives the appearance there is no danger.

A **levee** is a manmade structure, usually an earthen embankment or concrete floodwall, designed and constructed to contain, control, or divert the flow of water to provide reasonable assurance of excluding temporary flooding from the leveed area. There are no known levees in the planning area.

4.4.2 Previous Occurrences

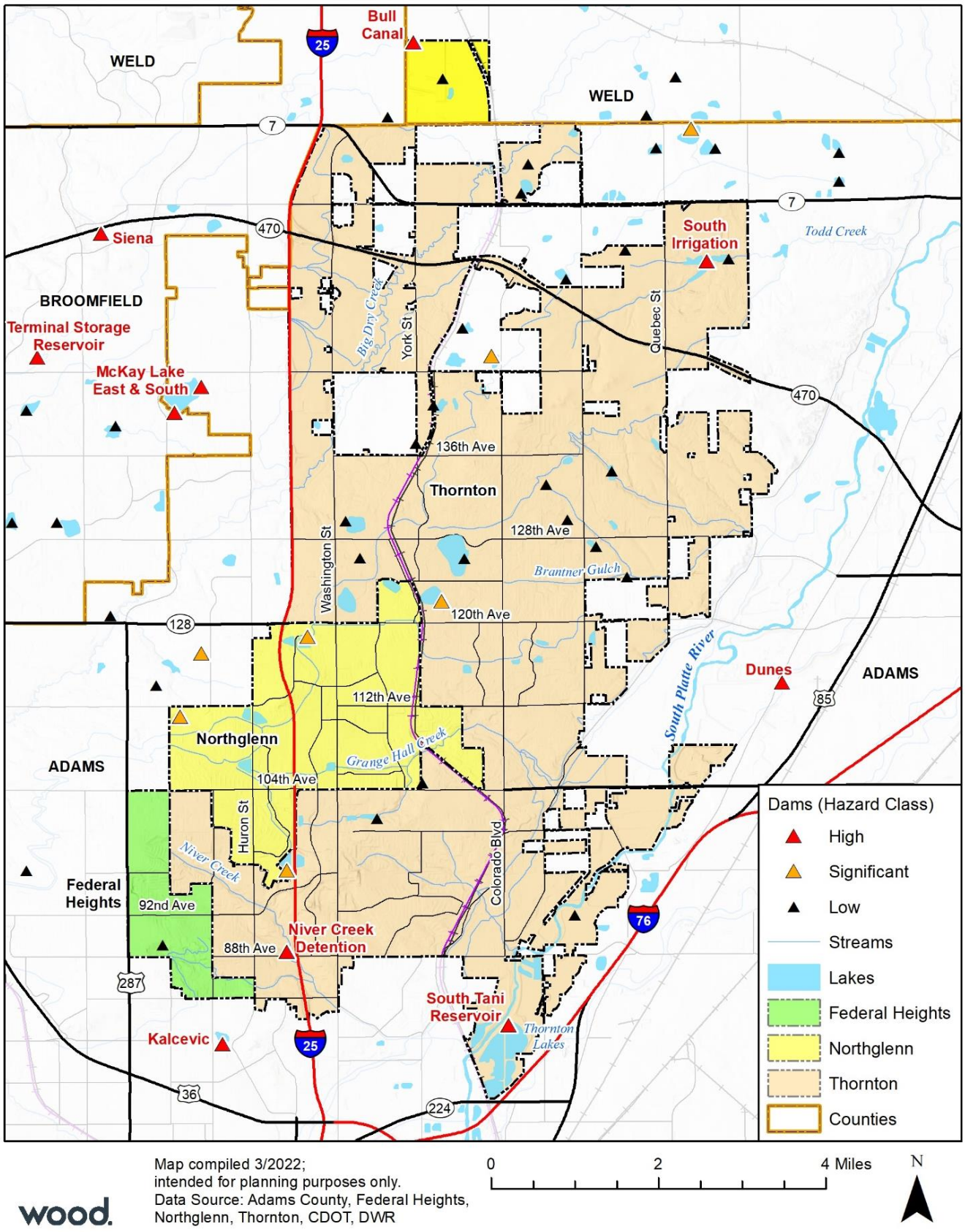
The ASDSO's Dam Incident Database contains one record of a non-failure event that occurred in Northglenn on November 11, 2012, at the Northglenn Terminal dam, which has a significant hazard potential rating. The incident was caused by a spillway pipe failure due to deterioration and resulting in uncontrolled leakage from a deteriorated outlet conduit. The leak was sealed with an inflatable bulkhead and the dam was planned for full replacement.

No other records of dam failure or dam incidents could be found for the planning area.

4.4.3 Location

There are 19 dams in or immediately upstream of the planning area that could result in inundation in the planning area in the event of their failure or overtopping. These dams are listed in Table 4-14 and mapped in Figure 4-2. Dam inundation maps for the planning area are located in Appendix H along with the complete list of 102 dams in surrounding counties that have the potential to impact the planning area.

Figure 4-2 Dam Locations



The geographic extent of dam inundation is **limited** in Northglenn and Thornton, and effectively **none** in Federal Heights.

Table 4-14 Dams in and Upstream of the Planning Area

Dam ID	Dam Name	Hazard Class	Owner	County	River
20607	Bull Canal (Main Reservoir)	High	City Of Northglenn (Kent Kisselman)	Weld	Big Dry Creek
20651	Dunes	High	Denver Board Of Water Commissioners	Adams	South Platte River
20212	Great Western	High	City Of Broomfield (Middleton, Brennan)	Broomfield	Walnut Creek
70201	Kalcevic	High	Adams County (Beshara Najjar)	Adams	Clear Creek
60202	Mckay Lake - East	High	City Of Westminster (Larsen, Rod)	Adams	Big Dry Creek
60324	Mckay Lake - South	High	City Of Westminster (Larsen, Rod)	Adams	Big Dry Creek
20411	Nissen #2	High	Eagle Trace Golf Club (Don Deschepper)	Broomfield	Big Dry Creek
20418	Niver Creek Detention	High	City Of Thornton (Eberly, Matt)	Adams	South Platte River
20325	Smith Irrigation	High	Todd Creek Village Metro District (Mr. Don Summers)	Adams	Todd Creek
20652	South Tani Reservoir (East Gravel Lakes)	High	City Of Thornton (Eberly, Matt)	Adams	South Platte River
60315	Terminal (Glasser)	High	City Of Broomfield (Middleton, Brennan)	Broomfield	Big Dry Creek
70303	Badding (Croke 12 West)	Significant	City Of Thornton (Eberly, Matt)	Adams	South Platte River
20125	East Lake #2	Significant	City Of Thornton (Eberly, Matt)	Adams	Brantner Gulch
20601	Northglenn Terminal	Significant	City Of Northglenn (Kent Kisselman)	Adams	Big Dry Creek
20322	Signal #1	Significant	Todd Creek Village Metro District (Mr. Don Summers)	Adams	Big Dry Creek
20501	The Ranch	Significant	The Ranch (Jeff Therrien)	Adams	Big Dry Creek
20337	Wadley #1	Significant	Wadley Farms Filing 3 (Jansen David, Homestead Management Corp,)	Adams	Big Dry Creek
20407	Webster Lake East	Significant	City Of Northglenn (Kent Kisselman)	Adams	Big Dry Creek
70313	Westminster Lake (Jim Baker Reservoir)	Significant	City Of Westminster (Krugmire, Robert)	Adams	Clear Creek
20607	Bull Canal (Main Reservoir)	High	City Of Northglenn (Kent Kisselman)	Weld	Big Dry Creek
20651	Dunes	High	Denver Board Of Water Commissioners	Adams	South Platte River

Source: Colorado Division of Water Resources

4.4.4 Magnitude/Severity

In general, three factors influence the potential severity of a full or partial dam failure:

- Height and construction of the dam
- Amount of water held by the dam
- Extent of downstream development and infrastructure

The four hazard classifications discussed above – high, significant, low, or no hazard – are a useful shorthand for determining how much damage is likely to occur.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property, challenging local response capabilities and requiring evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, and homes. Electric generating facilities and transmission lines could also be damaged and affect life support systems in communities outside the immediate hazard area. Associated water supply, water quality, and health concerns could also be an issue.

A map showing potential inundation areas for dams in and upstream of the planning area is located in Appendix H. As discussed below, in the planning area there are an estimated 6,372 people as well as 2,917 worth over $1.4 billion potentially exposed to dam inundation. While it is extremely unlikely, they would all be impacted at once, the figures still help give a sense of how damaging a major dam failure could be. The potential severity of a dam failure is **critical** in Thornton, **moderate** in Northglenn, and **negligible** in Federal Heights.

4.4.5 Probability of Future Occurrences

Dam failures and dam incidents are infrequent occurrences. Only one non-failure incident has occurred within the planning area according to available data. The likelihood of a dam failure incident in **unlikely**.

4.4.6 Climate Change Considerations

With a potential for increase in extreme precipitation events due to climate change, dam failure and dam incidents could become a larger issue as increased rainfall events may result in greater stress on dam infrastructure. Dams are designed partly based on assumptions about a river's flow behavior. Changes in weather patterns can have significant effects on a river's flow. If the river flow changes, it is conceivable that the dam can lose some or all its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams have historically experienced increases in stream flows from earlier dam releases.

Dams are constructed with safety features known as spillways. Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events can result in increased discharges downstream and increased flooding potential. Climate change may increase the probability of spillway overflows.

4.4.7 Vulnerability Assessment

People

People located downstream of a dam may be vulnerable to dam failure, though the level of risk can depend on topography, the amount of water in the reservoir at the time of breach, and the time of day of the breach among other factors. High hazard potential dams are those that could result in loss of human life if they fail. Injuries and fatalities can result from floodwaters or flood-borne debris. While threat to life safety is lower from significant hazard potential dams, failure of these structures may still result in negative impacts on people through economic loss, environmental damage, and disruption of community lifelines.

The exposure of people to dam inundation was estimated based on the number of residential parcels exposed to dam inundation and the average household size by jurisdiction. There are 13 residential buildings and 38 people exposed to potential dam inundation in Northglenn. There are 2,131 residential buildings (including mobile homes) located in dam inundation areas in the City of Thornton; given the Census average household size of 2.99 people per household in Thornton, there are an estimated 6,372 people exposed to dam inundation in the planning area. In the Thornton Growth Areas, there are 593 residential buildings (including mobile homes) and an estimated 1,647 people in the inundation area. There are no residential properties in inundation areas in the City of Federal Heights.

General Property

Properties located downstream of a dam and within the inundation area are vulnerable to dam failure. Properties closest to the dam would experience the largest, most destructive surge of water.

Per dam inundation limit data from the Colorado Division of Water Resources, there are no inundation areas in Federal Heights or the main City of Northglenn limits. However, there are inundated areas in the City of Thornton and in the Weld County portion of Northglenn on currently unimproved parcels. Table 4-15 below summarizes building exposure to dam inundation in the planning area. In total there are 2,917 buildings worth over $1.4 billion potentially at risk.

Table 4-15 Building Exposure to Dam Inundation by Jurisdiction

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Northglenn	Agricultural	13	19	$2,885,013	$2,885,013	$5,770,026
	Exempt	3	8	$5,686,391	$5,686,391	$11,372,782
	Residential	7	13	$2,619,838	$1,309,919	$3,929,757
	Total	**23**	**40**	**$11,191,242**	**$9,881,323**	**$21,072,565**
Thornton	Agricultural	2	9	$305,936	$305,936	$611,872
	Commercial	26	29	$59,045,321	$59,045,321	$118,090,642
	Exempt	15	27	$125,256,714	$125,256,714	$250,513,428
	Mobile Home	1	201	$15,075,000	$7,537,500	$22,612,500
	Residential	1,869	1,930	$601,010,248	$300,505,124	$901,515,372
	Total	**1,913**	**2,196**	**$800,693,219**	**$492,650,595**	**$1,293,343,814**
Thornton Growth Areas	Agricultural	20	75	$5,936,086	$5,936,086	$11,872,172
	Commercial	1	3	$1,000	$1,000	$2,000
	Exempt	7	42	$12,267,456	$12,267,456	$24,534,912
	Residential	487	551	$63,520,429	$31,760,215	$95,280,644
	Total	**515**	**671**	**$81,724,971**	**$49,964,757**	**$131,689,728**
Thornton-Owned Properties	Exempt – Larimer	8	8	$554,468	$554,468	$1,108,936
	Exempt - Weld	2	2	$0	$0	$0
	Total	**10**	**10**	**$554,468**	**$554,468**	**$1,108,936**
GRAND TOTAL		**2,461**	**2,917**	**$894,163,900**	**$553,051,143**	**$1,447,215,043**

Source: Adams County Assessor, Weld County Assessor, Colorado DWR

Critical Facilities and Infrastructure

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical facilities and infrastructure. Any critical asset 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.

Table 4-16 Critical Facilities with Dam Inundation Exposure by Jurisdiction

FEMA Lifeline	Federal Heights	Northglenn	Thornton	Thornton Growth Area	Total
Communications	-	-	6	8	**14**
Energy	-	-	-	1	**1**
Food, Water, Shelter	-	-	9	8	**17**
Hazardous Material	-	-	15	6	**21**
Health and Medical	-	-	1	-	**1**
Safety and Security	-	1	5	15	**21**
Transportation	-	-	24	10	**34**
Total	**-**	**1**	**60**	**48**	**109**

Source: HIFLD, CDPHE, NBI, 2020 Adams County HMP, City of Thornton, Colorado DWR

Economy

Depending on the circumstances and location of the breach, dam failure can have significant impacts on the 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.

Historic, Cultural and Natural Resources

Failure of a dam could result in loss of the upstream reservoir, introduction of foreign elements to local waterways downstream, and destruction and disruption of downstream habitats. Significant erosion could also occur during a dam failure, changing the downstream river's shape and flow patterns.

Land Use and Development

Plans for future development should consider potential impacts from upstream dam failure risk. It is notable that over 17% of the growth areas identified by the City of Thornton are at risk of dam inundation.

In the case of a dam failure, inundation would likely follow some existing FEMA mapped floodplains, which contain development restrictions for areas in the 1% annual chance floodplain, but it could exceed those floodplains. Development below a low hazard dam could increase its hazard rating by adding to downstream exposure and potential for loss of life and property.

4.4.8 Jurisdictional Differences

The City of Federal Heights does not have any exposure to mapped inundation areas, and as such is not at risk to flooding from a dam incident or failure.

The extent of potential dam inundation in the City of Northglenn is limited to the northern portions of Northglenn in Weld County, north of 168th Avenue. This area is largely rural in nature; however, analysis shows there is an estimated $21 million in total property value potentially exposed to dam inundation in this area.

The risk of dam inundation is significantly higher in the City of Thornton, primarily in the existing floodplains of the South Platter River and Big Dry Creek. An estimated $1.3 billion in total property value and 6,372 people are exposed to this hazard in Thornton. An additional $132 million in property value and 1,647 people in the City's growth area are exposed to risk of dam inundation.

The risk from dam failure/inundation was not profiled in the 2017 HMP.

4.4.9 Risk Summary

- The overall significance of this hazard to the planning area is **medium** in Thornton and **low** in the rest of the planning area.
- A total of 8,058 people are potentially at risk of dam failure or incident events based on the dam inundation analysis.
- A total of 2,907 buildings are potentially exposed to dam failure incident events, with over $1.4 billion in total values exposed.
- A total of 109 critical facilities are potentially exposed to dam failure events. Transportation, safety and security, and hazardous materials facilities are the most noted in the dam inundation analysis.
- A dam failure and loss of water from a critical reservoir or structure could include direct and indirect business and industry damages or disruption of the local economy and key resources (e.g., potable water).
- There are several dams upstream of the planning area that could impact the cities, although the fact that they are several miles away means the cities would have more time for warning and evacuations.
- Related hazards: Flooding, Earthquake.

4.5 Drought and Excessive Heat

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Moderate	Likely	**Medium**
Northglenn	Extensive	Moderate	Likely	**Medium**
Thornton	Extensive	Moderate	Likely	**Medium**

4.5.1 Description

Drought is a normal part of virtually all climates, including areas with high and low average rainfall. Drought events are caused by a deficiency of precipitation and can be aggravated by other factors such as high temperatures, high winds, and low relative humidity.

Droughts can be grouped as meteorological, hydrologic, agricultural, and socioeconomic. Representative definitions commonly used to describe the various types of droughts are summarized below.

- **Meteorological drought** is defined solely on the degrees of dryness. It is expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- **Hydrologic drought** is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- **Agricultural drought** is defined principally in terms of soil moisture deficiencies relative to water demands of plant life, usually crops.
- **Socioeconomic drought** associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of a weather-related supply shortfall. The incidence of this type of drought can increase because of a change in the amount of rainfall, a change in societal demands for water (or vulnerability to water shortages), or both.
- **Aridification** refers to long-term drought conditions resulting from climate change. While the term drought implies that a return to "normal" condition sooner or later, aridification recognizes that drought conditions may become the "new normal."

Each of the above definitions of drought can be measured on different scales and scopes and by a variety of metrics, such as precipitation, soil moisture, streamflow, and surface water and groundwater levels. Additionally, each definition can provide a different point of view or understanding of drought severity and impacts. Several unique indices have been developed to describe drought and measure its severity. It is important to understand that each of these indices measures drought as it occurs but does not predict future drought conditions.

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 4-17 Drought Severity Classification

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; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures;fire risk high; streams, reservoirs, orwells 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.

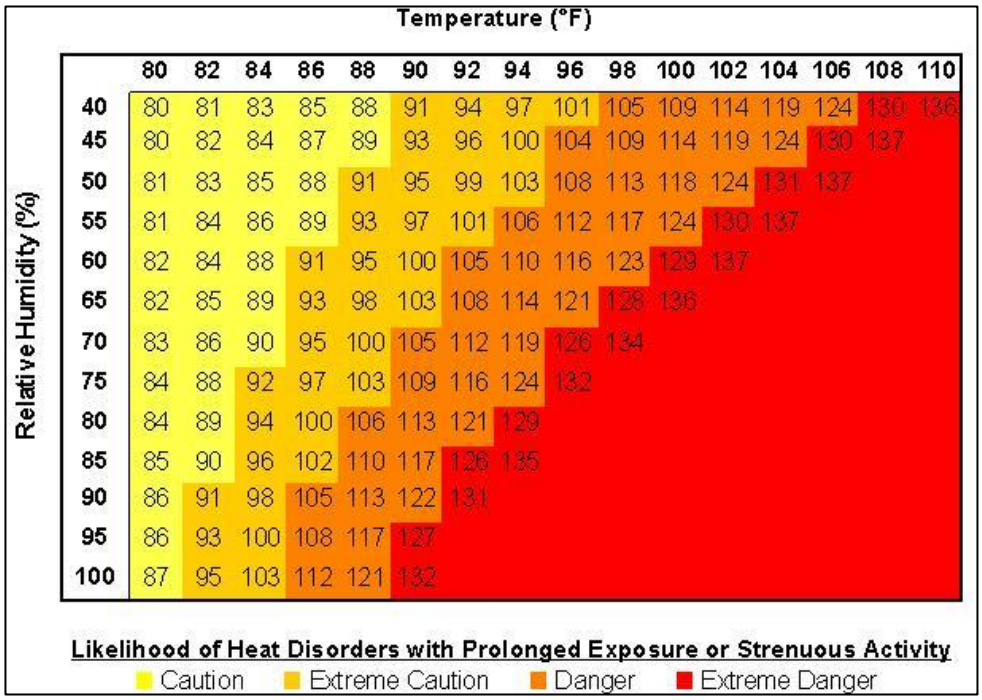
Excessive Heat

Excessive/extreme heat is defined in the State Hazard Mitigation Plan 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." Excessive/extreme heat events are a considerable public health concern and are one of the leading weather-related killers in the United States. Although extreme heat events can occur in May or September, they are most common between June and August when above average temperatures are sustained for a prolonged period. During extended periods of very high temperatures, or high temperatures coupled with high humidity, individuals can suffer a variety of health problems, including heatstroke, heat exhaustion, and heat cramps. Rising temperatures and increased sunlight can also cause more occurrences of freshwater algae blooms. Algae blooms occurs when there is a rapid increase in algae and can be harmful when humans or animals make contact with the affected water. It is useful to consider the extreme heat hazard in conjunction with drought because of the direct impact high temperatures can have on drought incidence. Extreme heat can occur quickly and without warning.

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 4-3 shows how ambient temperature and relative humidity impact the relative intensity of heat conditions.

The shaded zone above 105°F corresponds to a heat index that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

Figure 4-3 Heat Index Chart



Source: National Weather Service (NWS) http://www.nws.noaa.gov/os/heat/heat_index.shtml
Note: Exposure to direct sun can increase Heat Index values by as much as 15°F.

Although lower relative humidity contributes to a lower overall heat index, excessively dry and hot weather can also be dangerous. These conditions can cause dust storms and low visibility and can contribute to more severe drought as well as dangerous fire conditions.

The elderly, outdoor laborers, low-income families, the homeless, and the infirm are the most likely to suffer the negative effects of extreme heat. The National Weather Service initiates alerts based on the Heat Index as shown in the table below.

Table 4-18 Extreme Heat Warnings

Intensity	Detailed Description
Heat Advisory	Typically, between 105°F to 110°F (41°C to 43°C) for 3 hours or more during the day and at or above 75°F (24°C) at night.
Excessive Heat Warning	Typically, above 105°F (41°C) for 3 hours or more during the day and at or above 80°F (27°C) at night.

Source: National Weather Service

4.5.2 Previous Occurrences

Drought is a regular and widespread occurrence in the State of Colorado. Table 4-19 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 4-19 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:

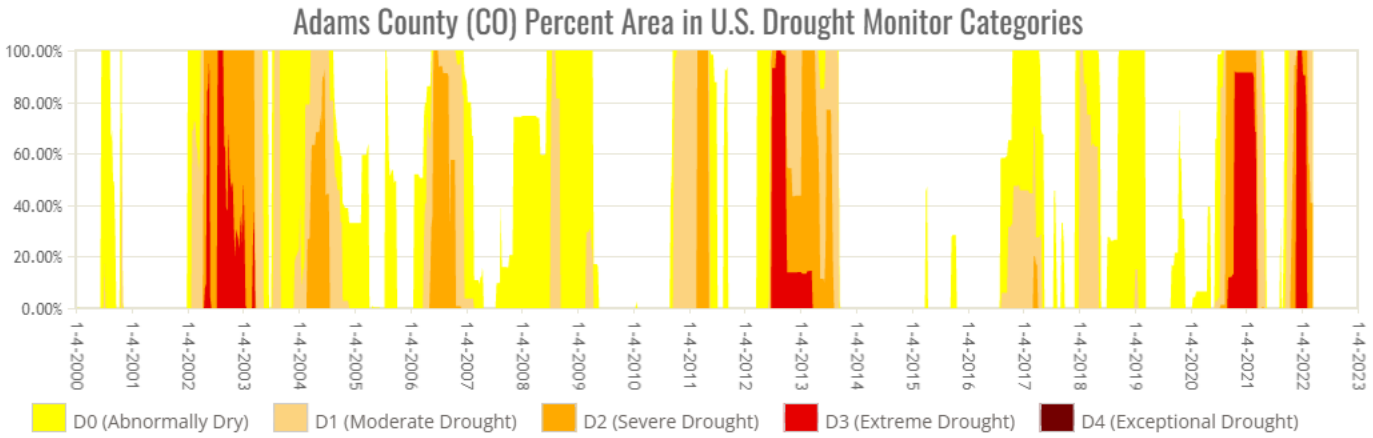
- **The 1930s Drought:** The Dust Bowl drought severely affected much of the United States during the 1930s.
- **The 1950s Drought:** During the 1950s, the Great Plains and the southwestern US withstood a five-year drought, and in three of these years, drought conditions stretched coast to coast. The 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 statewide, 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. Statewide 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.

As noted in Section 4.1.2, Adams County has received eleven drought declarations since 2000, including three since the 2017 Plan. Historical drought occurrence and intensity data reported by the U.S. Drought Monitor indicates that over the 1196-week period from January 2000 through December 2022, Adams County experienced 219 weeks in Severe Drought or worse conditions; this equates to 18% of the time period. Adams County data has been used as the majority of the planning area is in that County.

Additionally, NCEI records five heat events impacting western Adams County: four in 2000 and one on 2012. No deaths, injuries, or damages were reported associated with these events.

Figure 4-4 Adams County Drought Intensity, 2000-2022



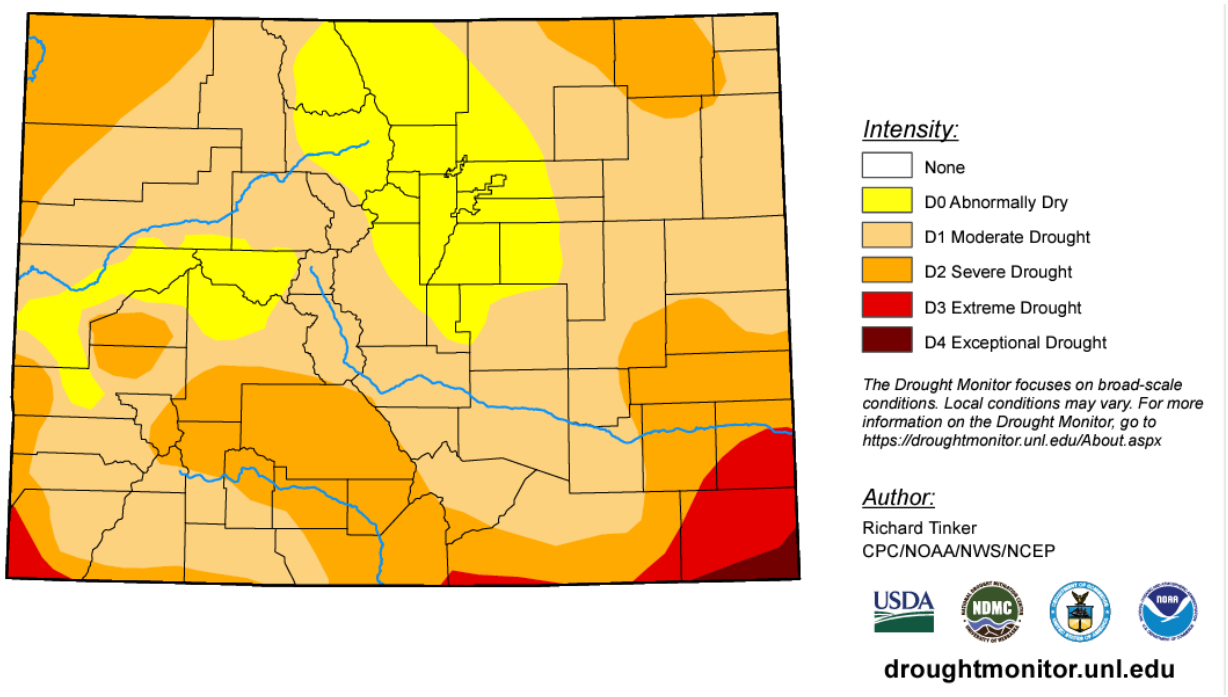
Source: US Drought Monitor

4.5.3 Location

Drought is regional in nature and can occur anywhere in the State, affecting all or part of the planning area at any given time. The geographic extent is **extensive**. Adams County data has been used as the majority of the planning area is in that County.

Figure 4-5 shows the U.S. Drought Monitor for Colorado as of April 12, 2022. As shown in the figure, the planning area is already experiencing D0-D1 mild-to-moderate drought conditions.

Figure 4-5 U.S. Drought Monitor Snapshot, April 12, 2022



Extreme heat events are generally regional in nature; however, urbanized areas can experience pockets of heightened temperatures where surfaces such as pavement and roofs become hotter than the air temperatures, a phenomenon known as the urban heat island effect. These hot surfaces also retain heat, causing high temperatures to persist even when air temperature drops. Per the EPA, "the annual mean air temperature of a city with one million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. On a clear, calm night, however, the temperature difference can be as much as 22°F" (US EPA).

4.5.4 Magnitude/Severity

Drought severity can be defined in terms of intensity using the U.S. Drought Monitor scale. The U.S. Drought Monitor Scale measures drought episodes with input from the Palmer Drought Severity Index, the Standardized Precipitation Index, the Keetch-Byram Drought Index, soil moisture indicators, and other inputs as well as information on how drought is affecting people. Table 4-20 details the classifications used by the U.S. Drought Monitor. A category of D2 (severe) or higher on the U.S. Drought Monitor Scale can likely result in crop or pasture losses, water shortages, and the need to institute water restrictions.

Table 4-20 U.S. Drought Monitor Classifications

			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Source: US Drought Monitor

The National Weather Service Heat Index Program provides a measure of the extent of typical health impacts of exposure to heat, summarized in Table 4-21. During these conditions, the human body has difficulties cooling through the normal method of the evaporation of perspiration, and health risks rise.

Table 4-21 Typical Health Impacts of Extreme Heat by Heat Index

Heat Index (HI)	Disorder
80-90° F (HI)	Fatigue possible with prolonged exposure and/or physical activity
90-105° F (HI)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F (HI)	Heatstroke/sunstroke highly likely with continued exposure

Source: National Weather Service Heat Index Program, www.weather.gov/os/heat/index.shtml

Drought impacts in the planning area can be wide-reaching: economic, environmental, and societal. The agricultural industry is expected to experience some crop losses as well as an increase in livestock feeding expenses and potentially livestock deaths. Water supply issues for municipal, industrial, and domestic needs will be a concern for the cities. 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. Overall, the potential severity of drought is **moderate**.

4.5.5 Probability of Future Occurrences

According to information from the Colorado Drought Mitigation and Response Plan, Colorado was in drought for 50 of the past 126 years (1893-2018). Thus, 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. If future occurrences continue to follow recent decades, Adams County has a 18% change of experiencing severe drought or worse conditions in any given week. Short duration droughts are likely, but longer periods of intense drought are less common.

Based on NCEI records of five heat-related events over the 20-year period from 2000 through 2021, Adams and Weld Counties has at least a 22.7% annual chance of experiencing heat-related hazards.

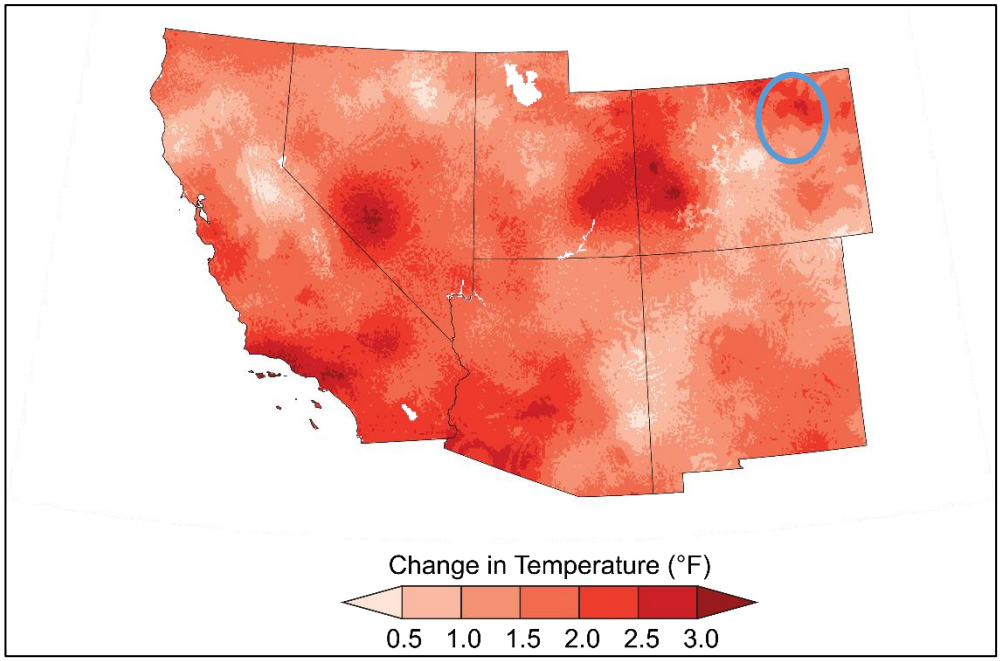
Future droughts and extreme heat events are **likely**. However, that probability is likely to increase in the future due to climate change, discussed in greater detail below.

4.5.6 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 4-6 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).

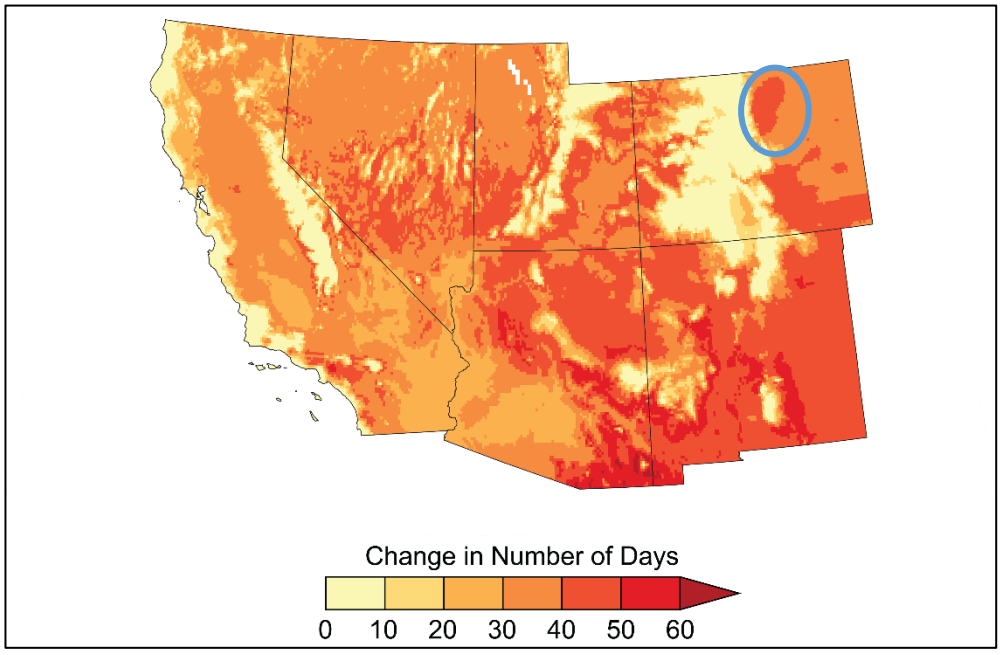
Figure 4-6 Change in Average Temperature Across the Southwest, 1901-1960 vs 1986-2016



Source: Fourth National Climate Assessment

In conjunction with rising average temperatures and their projected impact on drought, extreme heat is also expected to increase in frequency. Figure 4-7 shows projected increases in extreme heat as an increase in the number of days per year when the temperature exceeds 90°F by the period 2036-2065 compared to the period 1976-2005, with the planning area circled. Under the high emissions scenario, the number of days of extreme heat would increase in Adams and Weld Counties by 30 to 50 days.

Figure 4-7 Projected Increases in Extreme Heat, 2036-2065 vs 1976-2005



Source: Fourth National Climate Assessment

4.5.7 Vulnerability Assessment

People

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.

Though physical injury or death are not typically a result of drought, extreme heat can cause heat stroke or even fatality. The most dangerous place to be during an extreme heat incident is in a permanent home with little or no air conditioning. Those most vulnerable to heat-related illness include people 65 years of age or older, young children, people with chronic health problems such as heart disease, people who are obese, people who are socially isolated, and people who are on certain medications. Low-income families are less likely to have air conditioning and may be disproportionately impacted by rising water costs. Even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather or are not acclimated to hot weather.

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.

General Property

Drought and excessive heat do not 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.

While agricultural production in the three cities is relatively minor, exposure of agricultural property to drought is high in Adams County. Per the 2017 Census of Agriculture, there are 905 farms in the county with an estimated market value of $126,500,000 in crops and livestock. Approximately 309,468 acres, or 44% of the total farm acreage, is covered by crop insurance. According to the USDA RMA, during the 14-year period from 2007-2020, the sum of claims paid for drought in Adams County was $37,310,227. The 44% crop insurance coverage was factored into this

data to estimate total losses of insured and uninsured crops. The adjusted estimate of 14-year drought losses is $84,795,970. These losses equate to an annualized loss of $3,910,150 or 3.1% of the total market value.

Critical Facilities and Infrastructure

Buildings and infrastructure are not vulnerable to direct impact from drought; however, critical systems related to water supply can be affected. Decreased water levels in dams can cause structural damage. Low water levels can also affect wildfire protection capability.

Secondary hazards exacerbated by drought, such as wildfire and expansive soils, can cause direct structural impacts on critical facilities and infrastructure.

Prolonged heat exposure can have devastating 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.

Economy

Drought impacts on the cities' natural environment and the cascading impacts to the recreation sector could lead to less people visiting and spending money in the three cities, which could have a negative impact on the entire local economy. Extreme drought also has the potential to impact local businesses in landscaping and public utilities.

The Colorado Water Conservation Board (CWCB) maintains a Future Avoided Cost Explorer (FACE) tool, which estimates annual damages from drought. According to FACE analysis, the County of Adams could potentially experience $11,000,000 in losses annually in the future due to drought conditions under medium population growth and moderate climate scenarios.

Extreme heat can lead to potential loss of facilities or infrastructure function or accessibility and uninsured damages, potentially impacting cities' economy. Short term impacts can include direct or indirect interruptions in commerce as the public stays sheltered to avoid the heat. Short term impacts can also include elevated demand for energy sources. Long-term effects include impacts to water and energy usage. In addition, outdoor laborers who are exposed to extreme heat are at a high risk of heat related illnesses, and a long-term heat event could cause work interruptions.

Historic, Cultural and Natural Resources

Drought can affect local wildlife by shrinking food supplies and damaging habitats. Sometimes this damage is only temporary, and other times it is irreversible. Wildlife may face increased disease rates due to limited access to food and water. Increased stress on endangered species could cause extinction. Reduced food supply can also drive wildlife into greater proximity with humans. Extreme heat can have similar direct health impacts on natural resources such as plants, wildlife, and livestock.

Drought conditions can also provide a substantial increase in wildfire risk. As plants and trees die from a lack of precipitation, increased insect infestations, and diseases—all of which are associated with drought—they become fuel for wildfire. Long periods of drought can result in more intense wildfires, which bring additional consequences for the economy, the environment, and society. Drought may also increase likelihood of wind and water erosion of soils. Additional impacts may include the warming of stream and lake systems affecting aquatic species and an increased threat of pests, invasive species, and noxious weeds. 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.

Increased air temperatures can cause an increase in water temperatures in streams, rivers, and lakes. Elevated surface temperatures are transferred to stormwater during rain events, which is released in a water body and raises the temperature. Studies have shown that during rain events runoff from urban areas was about 20° to 30°F warmer than runoff from nearby rural areas. 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.

Finally, drought can have significant impacts on parks and green spaces that are maintained by the cities, driving up maintenance costs or forcing the cities to redesign landscaping in some areas.

Land Use and Development

Drought vulnerability is likely to be impacted by future development. Public demand for water, which impacts water levels, can exacerbate drought. The planning area 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 Table 4-22 indicates that water demand may surpass supply as soon as 2025 in the South Platte Basin, (which the City of Thornton relies majorly on for water sources), and 2030 in the Metro Basin (CDM, 2011). Water rights issues further complicate this matter.

Table 4-22 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

In terms of excessive heat, pre-emptive cautions such as construction of green buildings that require less energy to cool, use of good insulation on pipes and electric wirings, and smart construction of walkways, parking structures, and pedestrian zones that minimize exposures to severe temperatures may help increase the overall durability of the buildings and the community to the variations. Continued development also implies continued population growth, which raises the number of individuals potentially exposed to variations. 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 extreme heat. As Denver metropolitan urban development occurs the urban heat island effect grows, which could lead to increased likelihood of extreme heat events. This can be tempered somewhat by green infrastructure or low impact development.

4.5.8 Jurisdictional Differences

Given the fact that drought and excessive heat hazards tend to cover large geographic areas, the impact of drought and excessive heat hazards is expected to be similar among the three cities.

In the 2017 HMP, the Cities of Thornton and Northglenn ranked drought as high significance, while the City of Federal Heights ranked it as medium significance. For the 2023 update, a closer analysis of the actual impacts of drought led all three jurisdictions to rank it as medium significance.

4.5.9 Risk Summary

- The overall significance of drought in the planning area is **medium**.
- There have been eleven declared droughts in Adams County since 2000, together with five heat events recorded in the NCEI database.
- Both drought and excessive hazards are expected to continue to impact the three cities in the future; climate change will increase the frequency of these two hazards and exacerbate their impacts.
- Drought and excessive heat events can have extensive impacts on the wellbeing of the general public, the functioning of critical facilities and infrastructure, the natural environment, and resources, as well as the economy.

4.6 Earthquake

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Critical	Unlikely	**Low**
Northglenn	Extensive	Critical	Unlikely	**Low**
Thornton	Extensive	Critical	Unlikely	**Low**

4.6.1 Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. Earthquakes occur along faults. A fault is defined as a fracture or fracture zone in the earth's crust along which there has been displacement of the sides relative to one another. For planning purposes there are two types of faults, active and inactive. Active faults have experienced displacement in historic time, suggesting that future displacement may be expected. Inactive faults show no evidence of movement in recent geologic time, suggesting that these faults are dormant.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible ground shaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Other damaging effects of earthquakes include surface rupture, fissuring, ground settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, seiches, liquefaction, fires, and dam failure. The combination of widespread primary and secondary affects from large earthquakes makes this hazard potentially devastating.

Colorado's earthquake hazard is similar to other states in the intermountain west region. It is less than in states like California, Nevada, Washington, or Oregon, but greater than many states in the central and eastern United States. There are many unknowns about the earthquake hazard in Colorado, but the potential for damaging earthquakes does exist.

Factors Contributing to Damage

The damage associated with each earthquake is subject to four primary variables:

- **Seismic Activity:** The properties of earthquakes vary greatly from event to event. Some seismic activity is localized (a small point of energy release), while other activity is widespread (e.g., a major fault shifting or slipping all at once). Earthquakes can be very brief (only a few seconds) or last for a minute or more. The depth of release and type of seismic waves generated also play roles in the nature and location of damage; shallow quakes will hit the area close to the epicenter harder but tend to be felt across a smaller region than deep earthquakes.
- **Geology and Soils:** The surface geology and soils of an area influence the propagation (conduction) of seismic waves and how strongly the energy is felt. Generally, stable areas (e.g., solid bedrock) experience less destructive shaking than unstable areas (e.g., fill soils). The siting of a community or even individual buildings plays a strong role in the nature and extent of damage from an event.
- **Development:** An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that has no direct impacts. Large magnitude earthquakes that occur beneath the oceans may not even be felt by humans.
- **Time of Day:** The time of day of an event controls the distribution of the population of an affected area. On workdays, the majority of the community will transition between work or school, home, and the commute

between the two. The relative seismic vulnerability of each location can strongly influence the loss of life and injury resulting from an event.

Types of Damage

Often, the most dramatic evidence of an earthquake results from the vertical and/or horizontal displacement of the ground along a fault line. This displacement can sever transportation, energy, utility, and communications infrastructure potentially impacting numerous systems and persons. These ground displacements can also result in severe and complete damages to structures situated on top of the ground fault. However, most damage from earthquake events is the result of shaking.

Shaking: During minor earthquake events, objects often fall from shelves and dishes rattle. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, poorly constructed, or improperly (or not) designed for seismic events. Un-reinforced masonry buildings and wood frame homes not anchored to their foundations are typical victims of earthquake damage.

Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These "non-structural falling hazard" objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and property damage.

Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life. In areas of severe seismic shaking hazard, shaking Intensity levels of VII or higher (see Table 4-25) can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk.

Shaking also produces a number of phenomena that can generate additional damage:

Ground Displacement: Ground displacement can also occur due to shaking, resulting in similar damages as mentioned previously.

Landslides and Avalanches: Even small earthquake events can cause landslides. Rock falls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landslide activity, hampering response and recovery operations. Avalanches are possible when the snowpack is sufficient.

Liquefaction and Subsidence: Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils has the potential to cause widespread structural damage. The oscillation and failure of the soils may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like waterspouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

Seiches: Seismic waves may rock an enclosed body of water (e.g., lake or reservoir), creating an oscillating wave referred to as a "seiche." Although not a common cause of damage in past Colorado earthquakes, there is a potential for large, forceful tidal waves similar to a tsunami to be generated on the large reservoirs within and neighboring Weld County. Such a wave would be a hazard to shoreline development and pose a significant risk on dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding.

Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts are considered. Some examples of impacts are:

- Induced flooding and landslides
- Poor water quality
- Damage to vegetation

- Breakage in sewage or toxic material containments

4.6.2 Previous Occurrences

According to the U.S. Geological Survey (USGS), eastern Colorado is nearly aseismic, with just a few epicenters in the Arkansas and Platte River valleys. Most shocks in the history of Colorado have been centered west of the Rocky Mountain Front Range. The first seismographs in Colorado of sufficient quality to monitor earthquake activity were installed in 1962. Newspaper accounts are the primary source of published data for earthquake events before that time.

More than 500 earthquake tremors of magnitude 2.5 or higher have been recorded in Colorado since 1867. More earthquakes of magnitude 2.5 to 3 probably occurred during that time but were not recorded because of the sparse distribution of population and limited instrumental coverage in much of the state. For comparison, more than 20,500 similar-sized events have been recorded in California during the same period. Although many of Colorado's earthquakes occurred in mountainous regions of the state, some have been located east of the mountains. According to the USGS many of the events listed below impacted the wider Denver metro area and presumably future events of this scale could impact the cities of Thornton, Federal Heights, and Northglenn.

As mentioned previously, earthquakes are relatively infrequent in Colorado and records of historical earthquakes in and around the planning area are limited. The following table provides a list of Colorado's larger earthquakes recorded since 1870. The earthquakes that happened in NE Denver in the 1960's are thought to be associated with deep well injection of fluid wastes, a practice that was occurring at the Rocky Mountain Arsenal during that time period.

Table 4-23 Notable Earthquake Events in Colorado (1870-2015)

Date	Location	Magnitude (Richter)	MMI Scale
1870	Pueblo/Ft. Reynolds	-	VI
1871	Lily Park, Moffat County	-	VI
1880	Aspen	-	VI
1882	North Central Colorado	6.6*	VII
1891	Axial Basin (Maybell)	-	VI
1901	Buena Vista	-	VI
1913	Ridgeway Area	-	VI
1944	Montrose/Basalt	-	VI
1955	Lake City	-	VI
1960	Montrose/Ridgeway	5.5	V
1966	NE of Denver	5.0	V
1966	CO-NM border, near Dulce, NM	5.5	VII
1967	NE Denver	5.3	VII
1967	NE Denver	5.2	VI
2011	Southwest of Trinidad	5.3	VIII

Source: Colorado Geological Survey
*Estimated, based on historical felt reports

The most economically damaging earthquake in Colorado's history occurred on August 9th, 1967, in the Denver metro area. The 5.3 magnitude earthquake caused more than a million dollars of damage in Denver and the northern suburbs, including the planning area. The August 1967 earthquake was followed by an earthquake of magnitude 5.2 three months later in November 1967.

Although these two earthquake events cannot be classified as "major earthquakes," they are significant because of their location along the Front Range Urban Corridor, an area where nearly 75% of Colorado residents and many critical facilities are located. Historically, earthquake risk in Colorado has been rated lower than most subject matter

experts consider justified and seismologists predict that Colorado will experience another 6.5 magnitude earthquake at some unknown point in the future. It is critically important that local emergency managers in Thornton, Federal Heights, and Northglenn become fully aware of the size and consequences of an earthquake that could occur.

4.6.3 Location

Geological research indicates there are about 100 potentially active faults in Colorado with documented movement within the last 2.6 million years (Quaternary). Figure 4-8 indicates that potentially active faults do exist in the vicinity of the planning area that are capable of producing damaging earthquakes. There could be other faults in the state that may have potential for producing future earthquakes that are not known to be hazardous or do not rupture the ground surface.

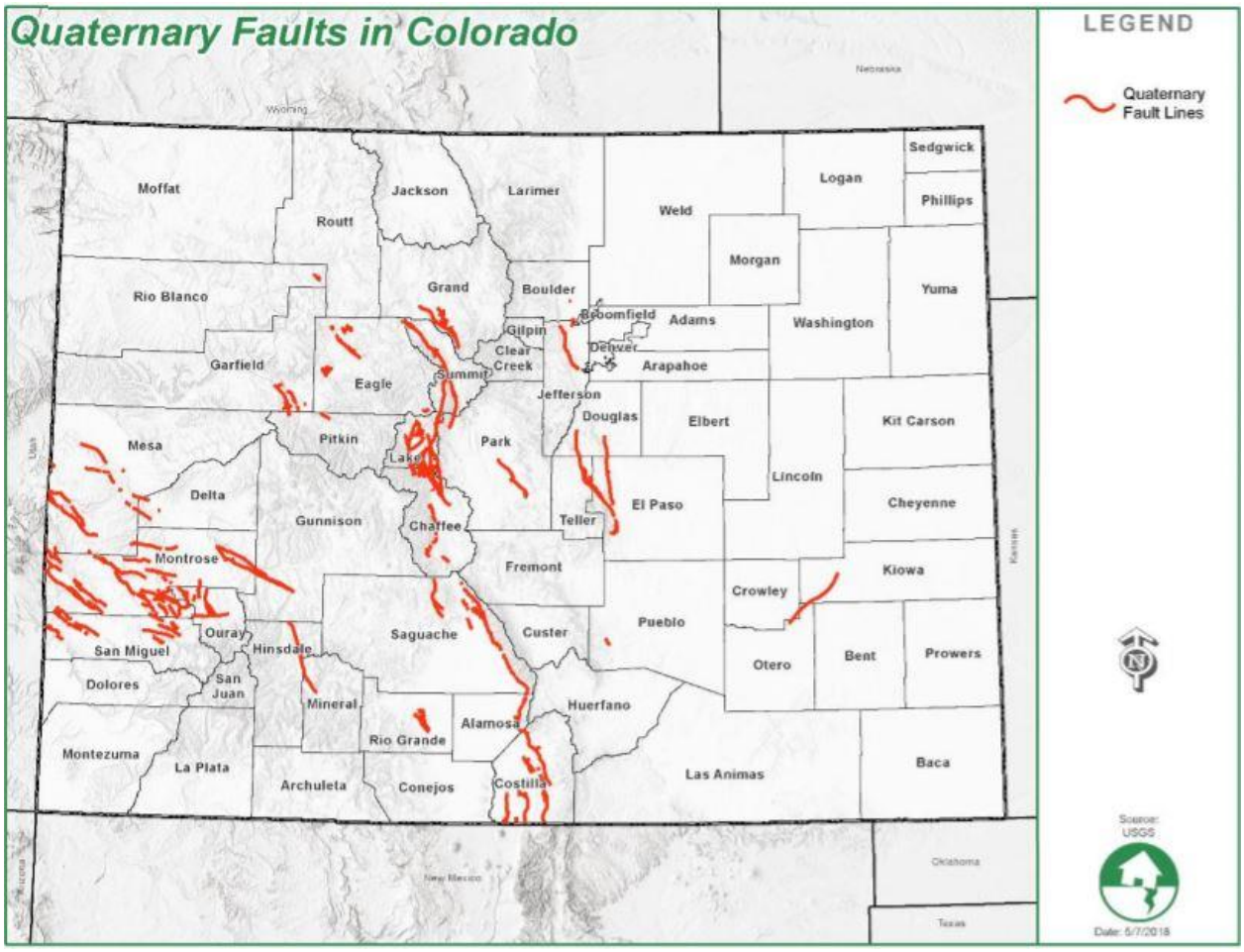
Faults have been classified based on the geologic time frame of their latest suspected movement (in order of activity occurrence, most recent is listed first):

- H—Holocene (within past 15,000 years)
- LQ—Late Quaternary (15,000-130,000 years)
- MLQ—Middle to Late Quaternary (130,000 - 750,000 years)
- Q—Quaternary (approximately past 2.6 million years)

Faults with evidence of movement in the past 130,000 years (Late Quaternary) are considered active faults. Faults that last moved between 130,000 and 1.8 million years ago may be considered potentially active. These active and potentially active faults are thought to be the most likely source for future earthquakes (Source: 2018 Colorado State Hazard Mitigation Plan). The primary potentially active fault in close proximity to the planning area is the Golden Fault, which is a Quaternary fault located in nearby Jefferson County. This fault runs along the base of the foothills west of Golden, roughly paralleling Highway 93 from Highway 72 to the north down to Highway 285 near Morrison, and is shown on the map in Figure 4-8, which is taken from a statewide map of Colorado earthquake hazards developed by the Colorado Geological Survey. The fault runs through sparsely developed sections of western Arvada, Golden, western Lakewood, and just east of Morrison. According to the Colorado Earthquake Evaluation Report associated with the Colorado Hazard Mitigation Plan the fault is thought to be capable of producing a M6.5 earthquake. The Colorado Late Cenozoic Fault, Fold, and Earthquake Database considers this a "suspect feature" that has not shown evidence of movement in the past 500,000 years, and that definitive evidence of Quaternary movement is lacking.

The geographic extent of earthquakes in the planning area is **extensive**.

Figure 4-8 Colorado Quaternary Fault Map



Source: State of Colorado Natural Hazard Mitigation Plan, 2018

4.6.4 Magnitude/Severity

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Seismologists have developed several magnitude scales; one of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology. The Richter Magnitude Scale is used to quantify the magnitude or strength of the seismic energy released by an earthquake; this has largely been replaced by the similar Moment Magnitude Scale. The impact an earthquake event has on an area is typically measured in terms of earthquake intensity. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale, which is detailed in Table 4-24 below and based on direct and indirect measurements of seismic effects.

Table 4-24 Modified Mercalli Intensity Scale

Intensity	Shaking	Description of effects	Richter Scale Magnitude
I	Not Felt	Not felt except by a very few under especially favorable conditions.	Up to 4.7
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an	

Intensity	Shaking	Description of effects	Richter Scale Magnitude
		earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.	
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.	4.8 – 5.3
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5.4 – 6.0
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6.1 – 6.8
VIII	Severe	Damageslight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	6.9 – 7.2
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	7.3 – 8.0

Another way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak ground acceleration (PGA) measures the strength of ground movements in this manner and represents the rate in change of motion of the earth's surface during an earthquake as a percent. PGA can be partly determined by what soils and bedrock characteristics exist in the region. Unlike the Richter scale, PGA is not a measure of the total energy released by an earthquake, but rather of how hard the earth shakes at a given geographic area (the intensity). PGA is measured by using instruments including accelerographs and correlates well with the Mercalli scale. PGA is represented as %g in the report. A description of PGA is provided in Table 4-25.

Table 4-25 Table of Intensity Descriptions

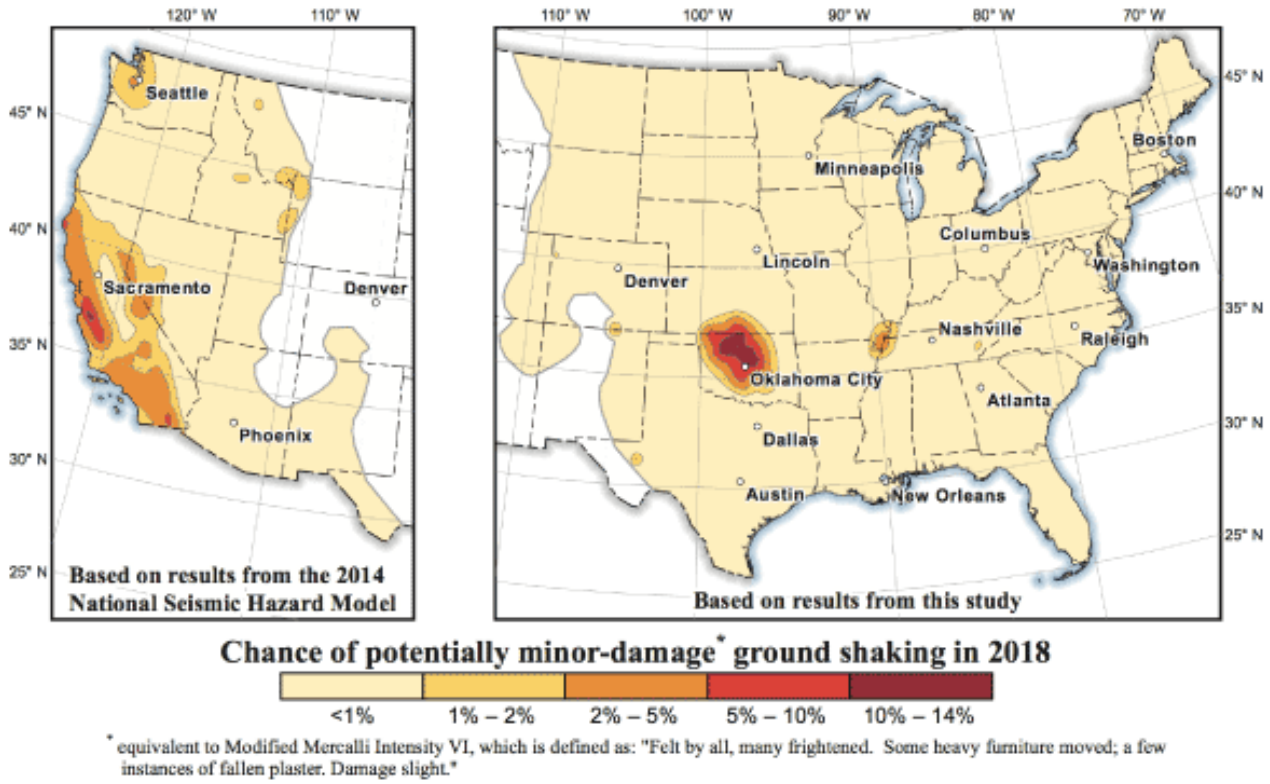
PerceivedShaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
PotentialDamage	none	none	none	Verylight	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
Peak ACC (%G)	< .17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
Peak VEL(CM/S)	< 0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
InstrumentalIntensity	I	II-III	IV	V	VI	VII	VIII	IX	X+

The potential severity of earthquakes in the planning area is **critical**.

4.6.5 Probability of Future Occurrences

In 2018, the USGS released probability maps showing chance of damage from an earthquake in the Central and Eastern United States during 2018. As shown in Figure 4-9, Denver has a less than 1% annual chance of damaging earthquakes (defined as MMI Intensity VI), which equates to a probability of **unlikely**.

Figure 4-9 Annual Probability of Damaging Earthquakes



Source: USGS Short-term Seismicity Model 2018

Even though the seismic hazard risk in the planning area is low to moderate, it is likely that earthquakes will occur in the planning area in the future. It is reasonable to expect future earthquakes as large as magnitude 6.5, the largest event on record in Colorado. Calculations based on the historical earthquake records and geological evidence of recent fault activity suggest that an earthquake of magnitude six or greater may be expected somewhere in Colorado every several centuries.

Earthquakes strike with little to no warning and can have multiple impacts on an area. After-effects from an earthquake can include impacted roadways, downed power and communication lines, fires, and damages to structures (especially poorly built, or those already in disrepair). Earthquakes are not a seasonal hazard, and thus can be experienced year-round. This fact presents its own set of planning and preparedness concerns.

Ultimately, the probability of an earthquake occurring in the planning area is low. Additionally, if an earthquake were to occur in the near future it is likely to be of a low magnitude, with expected damages to property and people to be minimal. History has shown, however, that the planning area and Colorado are at risk to a larger magnitude seismic event. Should that type of event occur, major damages and losses should be expected. This fact makes these low probability, high impact hazards a challenge to deal with when planning a mitigation strategy to combat all hazards faced by a community.

4.6.6 Climate Change Considerations

Climate change is not expected at this time to have any impacts on the probability of geological hazards such as earthquakes.

4.6.7 Vulnerability Assessment

As noted above, earthquakes strike with little to no warning and can have multiple impacts on an area. After-effects from an earthquake can include impacted roadways, downed power and communication lines, fires, and damages to structures (especially poorly built, or those already in disrepair).

In Colorado, earthquakes are considered low probability, high-consequence events. Although earthquakes may occur infrequently, they can have devastating impacts. Ground shaking can lead to the collapse of buildings and bridges, disrupt gas, electric, and phone service. Deaths, injuries, and extensive property damage are possible vulnerabilities from this hazard. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure. Moderate and even very large earthquakes are inevitable, although very infrequent, in areas of normally low seismic activity. Consequently, buildings in these regions are seldom designed to resist strong earthquakes, making them more vulnerable.

Earthquake vulnerability data was generated during the 2021 update using a Level 1 Hazus-MH analysis. Hazus-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up. The Hazus-MH earthquake scenario used was a 2,500-year Probabilistic earthquake, representing of a very strong earthquake with a 2% chance of exceedance in 50 years, with the model run for each of the three participating jurisdictions. The following vulnerability section will provide an overview of the earthquake vulnerability, with jurisdictional specifics from Hazus-MH detailed in the Jurisdictional Differences section.

People

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

Three population groups are particularly vulnerable to earthquake hazards:

- **Linguistically Isolated Populations**—Problems arise when there is an urgent need to inform non-English speaking residents of an earthquake event. They are vulnerable because of difficulties in understanding hazard-related information from predominantly English-speaking media and government agencies.

- **Population below Poverty Level**—Families with incomes below the poverty level may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Poorer residents are also less likely to have insurance to compensate for losses in earthquakes.
- **Population over 65 Years Old**—This population group is vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.
- Impacts on persons and households in the planning area were estimated for the 2,500-Year Probabilistic Earthquake. Further impacts to the population as estimated by Hazus are detailed in the Jurisdictional Differences section. It is estimated in a 2 p.m. time of occurrence scenario, which is likely to be a worst-case scenario, that there would be 58 injuries across the three cities, six of which would require hospitalization, and one fatality.

General Property

The Hazus analysis estimates that there are 55,000 buildings in the planning area, with a total replacement value of $15.9 billion. Because all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the total property exposure to seismic events. Most of the buildings (94.6%) and most of the associated building value are residential. According to the model about 2,218 buildings across the planning area will be at least moderately damaged. A summary of these damage estimates by jurisdiction is included in the Jurisdictional Differences section.

Property losses were estimated through the Level 1 Hazus-MH analysis for a 2,500-year probabilistic earthquake. The Hazus global summary report details two types of building loss estimates:

- Direct building losses, representing damage to building structures.
- Business interruption losses.

For the 2,500-year probabilistic earthquake scenario the estimated damage potential is $190.7 million. The Hazus analysis also estimated the amount of earthquake-caused debris in the planning area for the 2,500-Year probabilistic earthquake scenario event at 46,000 tons.

Critical Facilities and Infrastructure

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

Hazus-MH classifies the vulnerability of critical facilities to earthquake damage in two categories: at least moderate damage or complete damage. The analysis did not indicate any damages in these categories to specific facilities. The model also estimates lifeline damages to linear networks such as transportation and utilities. Economic losses to the transportation system are estimated at $610,000, and utility lifelines at $12.02 million.

Economy

Depending on the epicenter and magnitude, an earthquake could have a devastating impact on the economy of the planning area. In general, impacts would be related to debris cleanup and management, building and infrastructure damage, and losses related to business and infrastructure interruption. The total economic loss across the three cities is estimated at $203.35 million. Specific details on the types of losses by city are provided in the Jurisdictional Differences section.

Historic, Cultural and Natural Resources

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. Streams can be rerouted after an earthquake. Historic building stock is commonly made of unreinforced masonry, which is more vulnerable to damage from earthquakes, resulting in the bulk of building related losses.

Land Use and Development

With the unpredictable nature of earthquake epicenter locations, it is not feasible to identify specific areas where development may exacerbate the risk to an earthquake. It should be assumed that all development increases the risk to the planning area from the threat of earthquakes. As population and development continue to expand in the planning area, continued enforcement of the unified construction code has great potential to mitigate increasing vulnerability and development pressure. Standard building codes have the opportunity to provide the planning area with reasonable guidance for development throughout unincorporated and incorporated areas. Contractors and builders should be aware of applicable codes and regulations designed to reduce losses sustained by new and existing construction due to seismic hazards.

Earthquakes are relatively uncommon in the planning area and the probability is low that they will occur regularly in the future. However, if an event were to occur within the planning area, there is potential for significant structural damage to occur near the epicenter. Due to the nature of earthquake hazards, neighborhoods within the planning area with high population densities and large numbers of structures and critical facilities are expected to experience greater damage and loss from an earthquake event.

4.6.8 Jurisdictional Differences

The earthquake risk does not differ significantly across the planning area. Hazus-MH summary reports for each city can be found in the City Annexes.

All three Cities ranked earthquake as low significance in the 2017 HMP, and agreed that ranking is still valid for the 2023 update.

4.6.9 Risk Summary

Earthquakes represent a potentially high consequence but low probability hazard for the planning area; due to the low probability the overall significance is considered **low**.

- Colorado has much lower seismic activity compared to other Western states.
- Resulting damages to building stock and utility lifelines, and income related losses could equate to millions of dollars based on Hazus-MH modeling.
- Light casualties are anticipated.
- Earthquake risk is relatively the same across all participating jurisdictions, though impacts could be greater in areas with historic buildings and higher concentrations of people.
- The cost of retrofitting buildings to meet earthquake seismicity standards may be cost-prohibitive, but low-cost non-structural measures can reduce property loss and prevent injury
- Loss of facilities or infrastructure function/ability to provide services; power interruption is likely if not adequately equipped with backup generation
- A large-scale event will typically overwhelm emergency response and coordination services and may require mutual aid assistance from outside the impacted area
- Related hazards: hazardous materials, urban fires

4.7 Expansive Soils / Undermined Areas

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Negligible	Occasional	**Low**
Northglenn	Extensive	Negligible	Occasional	**Low**
Thornton	Extensive	Negligible	Likely	**Medium**

4.7.1 Description

Expansive Soils

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. In general, the term refers to both soil and bedrock contents although the occurrence of the two materials may occur concurrently or separately. The difference between the materials is that swelling soil contains clay, while swelling bedrock contains claystone.

The clay materials in swelling soils are capable of absorbing large quantities of water and expanding 10 percent or more as the clay becomes wet. The force of expansion is capable of exerting pressures of 15,000 pounds per square foot or greater on foundations, slabs, and other confining structures. 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 also 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

Damage caused by expansive soils/undermined areas may not occur within minutes, but it can pose serious risks to infrastructure and public safety over time. Damage due to expansive soils can be more than damage from floods, hurricanes, tornadoes, and earthquakes combined. Nationwide, annual losses due to expansive soils are estimated in the range of $2 billion.

Undermined Areas and Erosion

The underground removal of minerals and rock can undermine underground support systems and lead to void spaces. These voids can then be affected by natural and manmade processes such as caving, changes in flowage, or changes in overlying rock and soil material resulting in collapse or subsidence. Hazards from these abandoned sites are complicated by the fact that many final mine maps are inaccurate or incomplete. Mines operating after August 1997 were required by federal and state law to take potential surface subsidence into account; however, mining has been an activity in Colorado since the 1860s. There are some mapped, known mine hazard areas in Colorado but the potential exists for many more unknown mine hazard areas to be located throughout the state.

Undermined areas subject to land subsidence or soil erosion have the potential to threaten health, safety, and local economies and can interrupt critical services. Land subsidence is defined as the gradual settling or sudden sinking of the Earth's surface. A subsidence event can occur rapidly due to a sinkhole or the collapse of an underground mine. It can also occur during a major earthquake. Soil erosion and deposition involve the removal and transportation of earth materials occurring when soil is removed at a greater rate than it is formed. The natural geologic process of erosion has occurred since the Earth's formation and continues at a very slow and uniform rate. As with expansive soils, observing damage for subsidence or soil erosion in real-time can be difficult. It takes place

slowly, becoming more evident over the time span of many years. The impacts of a soil erosion event depend on the inherent properties of the soil, topography, vegetative cover, soil disturbance and rainfall intensity but can also affect human and animal health and create public safety hazards.

4.7.2 Previous Occurrences

Damage of varying degrees of severity occurs on an ongoing and seasonal basis. The frequency of damage from expansive soils is associated with the cycles of drought and heavy rainfall and also reflects changes in moisture content based on typical seasonal patterns. Building codes and structure ages also contribute to overall damages, as newer structures are usually built with more resistant techniques or as development restrictions in vulnerable areas minimize expansion and exposure. Published data summarizing damages specific to the planning area is not available, but it is assumed that a certain degree of damage to property and infrastructure occurs annually, as noted above.

Reliable, city-specific historical records of land subsidence or soil erosion events are sparse. Impacts related to expansive soils historically have been isolated and affected foundations of residential and commercial buildings. In areas of high swelling soils damage to foundations can lead to buildings being condemned. No evidence of this extent level has been recorded in the planning area. The HMPC did not report any instances of significant damage from expansive soils in the planning area.

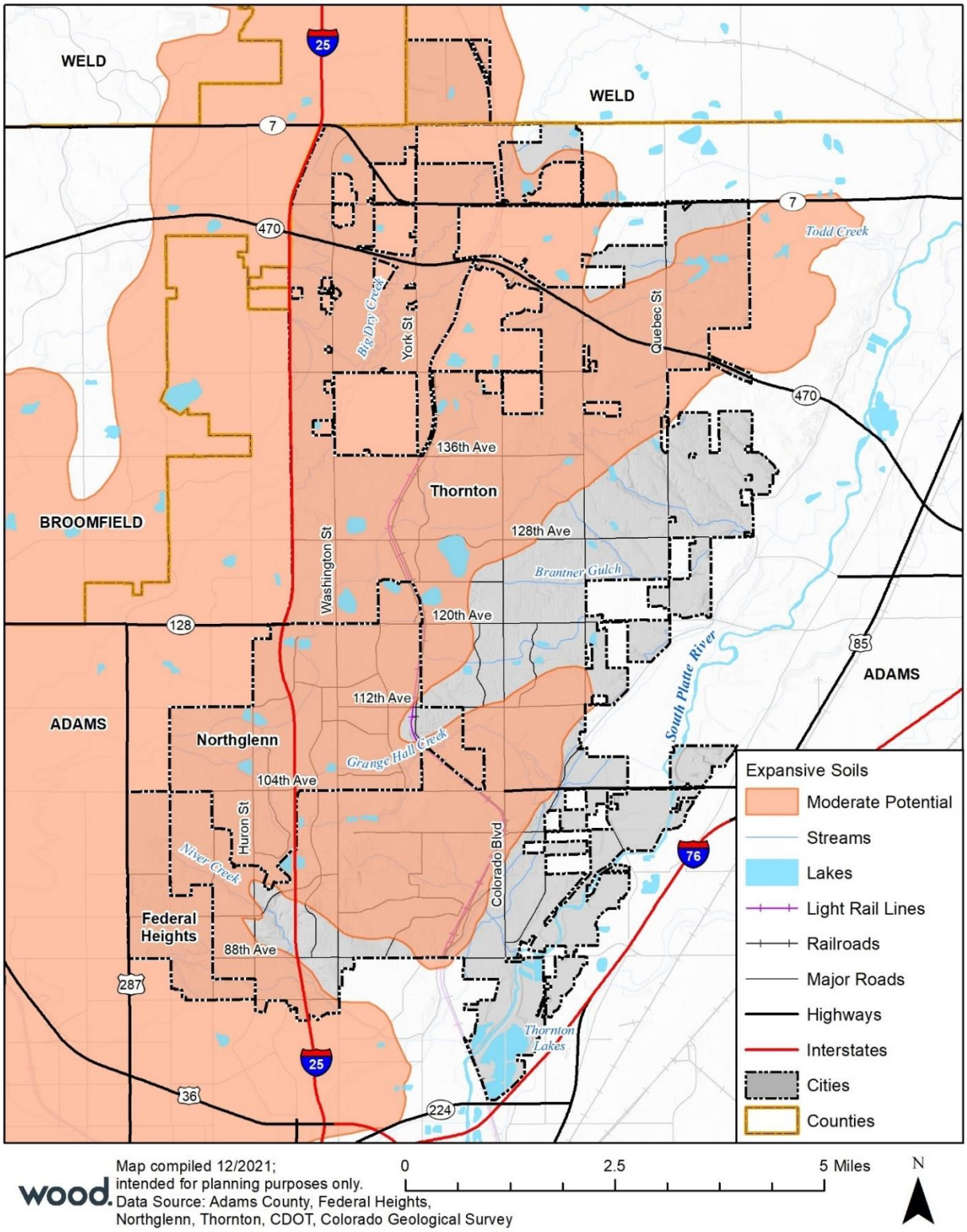
4.7.3 Location

According to the Colorado Geological Survey (CGS), approximately 50% of Colorado's soil has a very high potential for shrinking and swelling. Expansive soil information was gathered for the Thornton, Federal Heights, and Northglenn planning boundary using best available CGS data. The level of risk within the planning area is determined to be low to moderate. However, as development and population are expected to increase within the planning area, more structures and people may become exposed to expansive soils and risks in the future.

Swelling soils follow the rise of the Rocky Mountains along the western and southern portions of the Denver Metro Area. The extent of swelling soils across the planning area are shown in Figure 4-10 below, and includes the entirety of Federal Heights, more than 90% of Northglenn, and over two-thirds of Thornton's developed areas. The geographic extent of this hazard is **extensive** across the planning area.

The Colorado Division of Reclamation, Mining, and Safety maps the locations of abandoned or inactive mines across the state, which may be subject to collapse; they do not show any such areas in the planning area.

Figure 4-10 Soils with Swelling Potential



4.7.4 Magnitude/Severity

The potential magnitude and severity of expansive soils events and damages is estimated to be **negligible** for the planning area. As noted above, historically impacts related to expansive soils have been isolated and affected

foundations of residential and commercial buildings. Sporadic impacts related to expansive soils are experience on an ongoing basis, primarily affecting road infrastructure or private property. Because damages from expansive soils tend to happen over an extended period of time, it is difficult to estimate the potential severity of a problem. Many deposits of expansive soils do not inflict damage over large areas. Instead, these deposits can often create localized damage to individual structures and supply lines, such as sidewalks, foundations, roads, railways, bridges, and power lines.

Widespread subsidence in the area could damage houses, retail facilities, roads, sidewalks, utilities infrastructure, and critical infrastructure facilities located throughout the planning area. Such an event would not be expected to impact overall delivery of essential services and functions to the planning area, though the affected portions of the community may be impacted for weeks as water, gas, power lines, roads, and houses are repaired. If events are severe enough, structures may be deemed unsafe for continued occupancy, forcing residents to relocate. Injuries or deaths are possible, but not expected, in such an event.

4.7.5 Probability of Future Occurrences

The planning area has extensive development and engineering regulations to minimize the damages incurred by expansive soils and other geologic hazards. As such, while previous occurrences are certainly commonly known, it is reasonable to assume that damages and future occurrences should be decreasing.

Since comprehensive records of specific occurrences are not available to the planning process, it is challenging to accurately calculate probability for future events related to soil expansion/undermined area hazards. While minor shifting due to expansive soils is likely to continue, the likelihood of a significant event impacting the planning area is **occasional** for most of the planning area, although anecdotal reports suggest that the likelihood in Thornton is **likely**. As these hazards are both ongoing, natural geological processes it can be assumed, that these hazards will continue to alter the landscape of Thornton, Federal Heights, and Northglenn going forward.

4.7.6 Climate Change Considerations

Changing climate conditions are expected to affect soil resources in many ways. In areas where climate change results in decreased precipitation in the summer months and reduced surface-water supplies, communities are often forced to pump more ground water to meet their needs. In Colorado, the major aquifers are composed primarily of compressed clay and silt, soil types that are prone to compact when groundwater is pumped. Based on analysis of CGS data and the existing moderate hazard ranking, it is probable that the eastern portions of the planning area will experience more frequent soil hazards over time as a result of local climate change. It is important that these communities consider future mitigation actions that will address this hazard, particularly in rapidly growing areas. Changing climate norms are expected to affect soil resources in many ways. During hot, dry years annual grasses that stabilize and protect topsoil often fail to germinate or do not grow well. This leaves soil surfaces highly vulnerable to erosion from wind and precipitation.

Many soils and rocks have the potential to swell or expand based on a combination of its 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. Since the 1950s, snow precipitation and duration of snowpack have both decreased while rising temperatures have increase rate of water evaporating into the air and earlier runoff, creating drier soil conditions in Colorado (EPA 2016). More extremes in climate conditions (e.g., wet-dry conditions), could potentially exacerbate the swelling of expansive soil issues in the future.

4.7.7 Vulnerability Assessment

While soil expansion and undermined areas have been categorized as low to moderate risk hazards in Thornton, Federal Heights, and Northglenn, there has been property and infrastructure damage associated with these hazards within Colorado. In the semi-arid climate of Colorado, increases in seasonal precipitation, coupled with periods of prolonged drought, may accelerate processes of soil erosion, and increase the potential for undermined areas.

People

According to a GIS analysis conducted to evaluate property exposure, an estimated 130,790 residents of Thornton, Federal Heights, and Northglenn live in areas with soils with moderate expansion risk. However, the risk of injury or fatalities as a result of these hazards are very low. Spontaneous collapse and opening of voids are rare but could potentially cause death or injury to any people in the area at the time.

General Property

As identified in the hazard profile and noted above, extensive areas of the planning area are characterized to some extent by swelling soils. Older construction may not be resistant to the 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. Newer construction may have included mitigation techniques to avoid most damage from the hazard, but the dangers continue if mitigation actions are not supported by homeowners. For example, the maintenance of grading away from foundations and the use of appropriate landscaping near structures must be continued to prevent an overabundance of water in vulnerable soils near structures. While continued public education efforts may help increase compliance for landscaping and interior finishing mitigation actions, physical reconstruction of foundations is probably not feasible in all but the most heavily impacted of existing development. Therefore, damages may be expected into the future for existing structures.

GIS was used to create a risk assessment for exposure to expansive soils in the planning area. Expansive soil hazard data (shown in Figure 4-10 above) was overlaid on parcel and assessor's data from each city. For the purposes of the analysis, if the hazard zone intersects an improved parcel center, the parcel is counted in Table 4-26. Results are sorted by occupancy type and by jurisdiction to demonstrate how the hazard's risk varies across the planning area.

Table 4-26 Exposure of Buildings to Moderate Expansive Soils Hazard

Jurisdiction	Property Type	Improved Parcels	Buildings	Population
Federal Heights	Commercial	94	175	
	Exempt	30	80	
	Industrial	1	1	
	Mobile Home	10	2,025	5,994
	Residential	1,177	1,339	3,963
	Total	**1,312**	**3,620**	**9,957**
Northglenn	Agricultural	8	31	
	Commercial	265	378	
	Exempt	87	153	
	Industrial	13	17	
	Residential	9,101	10,354	30,027
	Total	**9,474**	**10,933**	**30,027**
Thornton	Agricultural	8	29	
	Commercial	411	518	
	Exempt	123	288	
	Industrial	2	2	
	Mobile Home	6	2,561	7,657
	Residential	26,188	26,766	80,030
	Total	**26,738**	**30,164**	**87,688**
Thornton Growth Areas Only	Agricultural	19	58	
	Commercial	3	6	
	Exempt	4	8	
	Residential	562	1,043	3,119

Jurisdiction	Property Type	Improved Parcels	Buildings	Population
	Total	**588**	**1,115**	**3,119**
Grand Total		**38,112**	**45,832**	**130,790**

Source: Colorado Geological Survey and Thornton, Northglenn, and Federal Heights Assessor's Data

This analysis outlines the potential exposure of improvements built on expansive soils for existing development in the planning area. In this analysis, improved structures are assumed to be potentially exposed, but not necessarily at risk. This analysis does not take into account site-specific mitigation measures that may be in place, thus estimating losses for expansive soils is difficult.

Critical Facilities and Infrastructure

Existing critical facilities impacted swelling 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. Schools built on the area may pose a danger to occupants if the buildings are severely damaged in an event. If building integrity is compromised, it may also reduce the sheltering capacity or public health distribution capacity of the County, as schools are often used for these functions. Buildings and infrastructure across Thornton, Federal Heights, and Northglenn may be vulnerable to the impacts of soil expansion, instability, and erosion-related hazards.

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

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

Critical facilities or infrastructure located along streams and waterways are exposed to risk from the hazard.

Economy

The economic cost of this hazard is typically minor in the short term, although over time they can add up to significant impacts. Road closures or detours during expansive soil repairs can result in temporary economic impacts.

Historic, Cultural and Natural Resources

Collapsible and 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 which may have less engineered resistance to these geologic processes.

Land Use and Development

Rapid and sustained population growth across Colorado and the Front Range has contributed to increasing trends in geologic hazard risk, exposure, and vulnerability. As development and populations continue to grow, especially in the north Thornton region, more structures and residents will be exposed to soil expansion and the existing undermined area.

Typically, the process of erosion does not limit land use, especially if efforts are made to minimize it. Erosion impacts can be reduced and controlled by surface drainage management, re-vegetation, or disturbed lands, controlling stream-carried eroded materials in sediment catchment basins, and riprapping of erosion-prone stream banks (especially adjacent to structures). Ground modification and structural solutions can help mitigate the threats

of localize erosion and deposition. Proper drainage and water management are also important to prevent increasing vulnerability to erosion and deposition hazards.

4.7.8 Jurisdictional Differences

The risk of expansive soils and undermined area hazards does not differ significantly across the planning area. The risk to Federal Heights and Northglenn is **low**. Thornton has described their risk as **medium**; one area near the south side of Thornton around the 88th Street and Welby Commuter Station has been determined to be of higher risk. This area contains bentonite soils, which has been affected due to recent flooding. Northglenn identified that soil within the community is considered sandy loam. Although public concern is not high, hazard mitigation efforts should still be considered for expansive soils/undermined areas.

In the 2017 HMP, the City of Thornton ranked expansive soils as medium significance while the Cities of Federal Heights and Northglenn ranked it as low significance. For the 2023 update, all three jurisdictions determined those rankings were still valid.

4.7.9 Risk Summary

- The risk from expansive soils in the planning area is **low** to **medium**.
- Areas at risk include includes all of Federal Heights, more than 90% of Northglenn, and over two-thirds of Thornton's developed areas.
- Damage from expansive soils generally take place slowly over a prolonged period.
- Modern building techniques typically reduce the risk from expansive soils for new construction.
- Related hazards: Drought.

4.8 Flood

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Significant	Moderate	Likely	**High**
Northglenn	Significant	Moderate	Likely	**High**
Thornton	Significant	Moderate	Likely	**High**

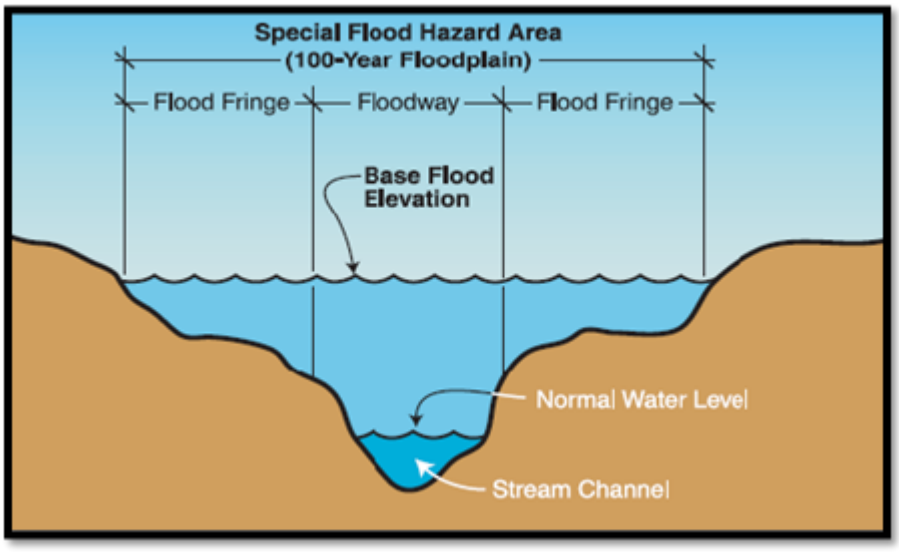
4.8.1 Description

A flood is a naturally occurring event for rivers and streams and occurs when a normally dry area is inundated with water. Excess water from snowmelt or rainfall accumulates and overflows onto the stream banks and adjacent floodplains. As illustrated in the figure below, floodplains are lowlands, adjacent to rivers, streams, and creeks that are subject to recurring floods. Flash floods, usually resulting from heavy rains or rapid snowmelt, can occur throughout the planning area. Additionally, extreme cold temperatures can cause streams and rivers to freeze, causing ice jams and creating flood conditions.

Floods are considered hazards when people and property are affected. Nationwide, hundreds of floods occur each year, making it one of the most common hazards in all 50 states and U.S. territories. Most injuries and deaths from flooding happen when people are swept away by flood currents and most property damage results from inundation by sediment-filled water. Fast-moving water can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can also cause extensive damage. Flooding can cause extensive damage to crop lands and bring about the loss of livestock. Several factors determine the severity of floods including rainfall intensity and duration, topography, and ground cover.

Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. Water from snowmelt, rainfall, freezing streams, ice flows, or a combination thereof, causes the river or stream to overflow its banks into adjacent floodplains. Winter flooding usually occurs when ice in the rivers creates dams or streams freeze from the bottom up during extreme cold spells. Spring flooding is usually the direct result of melting winter snowpacks, heavy spring rains, or a combination of the two.

Figure 4-11 Floodplain Terminology



Flash floods can occur anywhere when a large volume of water flows or melts over a short time period, usually from slow moving storms or rapid snowmelt. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a

few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Most flood deaths result from flash floods.

Urban flooding is the result of development and the ground's decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. Urbanization can increase runoff two to six times more than natural terrain. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it. Urban flooding can also result from infrastructure failures such as a water line break, or from improper diversions into stormwater drains that cannot handle the amount of water being diverted.

Previous flash flooding events have occurred within the planning area. The HMPC has expressed a desire and a need for better data and information specifically related to flash flooding so that appropriate mitigation strategies can be identified and implemented.

Stream bank erosion is measured as the rate of the change in the position or horizontal displacement of a stream bank over a period of time. It is generally associated with riverine flooding and discharge and may be exacerbated by human activities such as bank hardening and dredging.

Ice jams are stationary accumulations of ice that restrict flow through a waterway. Ice jams can cause considerable increases in upstream water levels, while at the same time, downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood or dam failure. Ice jam flooding generally occurs in the late winter or spring.

4.8.2 Previous Occurrences

Seasonally, the cities of Thornton, Federal Heights, and Northglenn are confronted with the possibility of flooding and flood-related hazards. Floods have the potential to inflict tremendous damage with significant losses of life and property. They can also pose a threat to the health, safety, and welfare of citizens. Previous flooding events have caused the region extensive damage in a matter of just a few hours or days. Current development and population growth trends necessitate a heightened awareness that the impact of flooding may likely increase over time.

Documentation of flooding in Colorado collected by NCEI goes back to 1950. The table below provides a history of major flood events that affected the cities of Thornton, Federal Heights, and Northglenn between 1950 and 2022. The NCEI database has no records of significant flooding in the planning area since the 2013 floods.

Table 4-27 Cities of Thornton, Federal Heights, and Northglenn Historical Flood Events (1950-2022)

Date	Location	Hazard Type	Injuries	Deaths	Property Damage	Crop Damage
6/3/1997	Southern Weld County	Flood	0	0	0	0
6/6/1997	Adams County	Flash Flood	0	0	0	0
5/1/1999	Southern Weld County	Flood	0	0	0	0
5/4/1999	Southern Weld County	Flood	0	0	0	0
8/4/1999	Adams County	Flash Flood	0	0	$500,000	0
7/16/2000	Adams County	Flood	0	0	0	0
8/17/2000	Adams & Weld Counties	Flash Flood	0	1	0	0
7/23/2004	Adams County	Flash Flood	0	0	0	0
9/12/2013	Adams County	Flash Flood	0	0	0	0
TOTAL:			**0**	**1**	**$500,000**	**0**

Source: NOAA (NCEI Storm Events Database)

Although damages within the planning area were minimal, the most significant flooding event to collectively impact the State of Colorado occurred during September 2013. During the week beginning on September 9th, a slow-

moving cold front circulated over the state, clashing with warm, humid monsoonal air from the south. This event sparked renewed commitment to resiliency planning and mitigation along the Front Range and across the state.

On June 11, 2015, the Denver metro area saw a heavy amount of rainfall, and several streets were flooded, leaving parked cars damaged or inoperable. Parts of the area saw almost three inches of rain and flash flood warnings were directed throughout the day.

Figure 4-12 Damages from 2013 Flood Event



Source: City of Thornton

4.8.3 Location

The planning area includes multiple rivers, streams, and creeks that can pose flooding risks. Figure 4-13 shows areas in the three cities with a 1% chance of flooding in any given year (also called the 100-year floodplain), as well as those with a 0.2% chance of flooding in any given year (also called the 500-year floodplain), based on FEMA's DFIRM. The different levels of flood risk can be better understood by referencing and reviewing the geographical locations Flood Insurance Rate Map (FIRM). The effective NFHL date for Thornton, Federal Heights and Northglenn is 12/02/21. While floodplains exist in all three cities, the geographic area at risk covers less than 2% of the planning area.

However, the HMPC felt that the FEMA floodplains understate the planning area's flood risk. More recent flood studies conducted by the Mile High Flood District (MHFD) have identified a number of additional areas and structures at risk of flooding. The MHFD flood mapping is shown in Figure 4-14. MHFD also maintains Major Drainageway Plans (MDPs) and Outfall System Plans (OSPs), which are long-term planning documents that identify projects to mitigate flooding risks; these plans are developed in partnership with local governments in the District, including Federal Heights, Thornton, and Northglenn.

It is important to remember that urban flooding can occur wherever there is heavy precipitation, not just in mapped floodplains.

Overall, the geographic extent of flooding is **significant**.

Figure 4-13 FEMA Floodplains in Federal Heights, Thornton, Northglenn

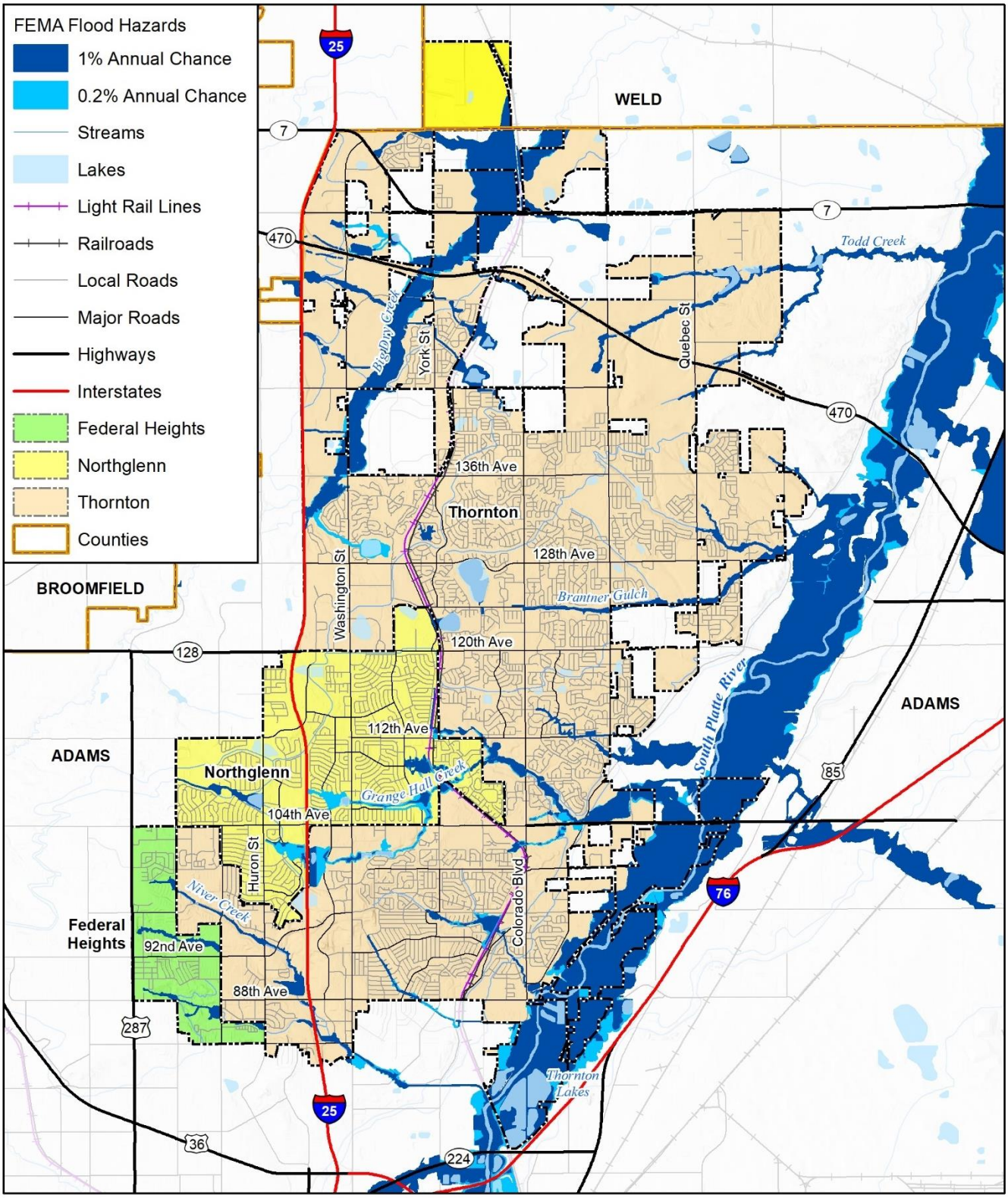
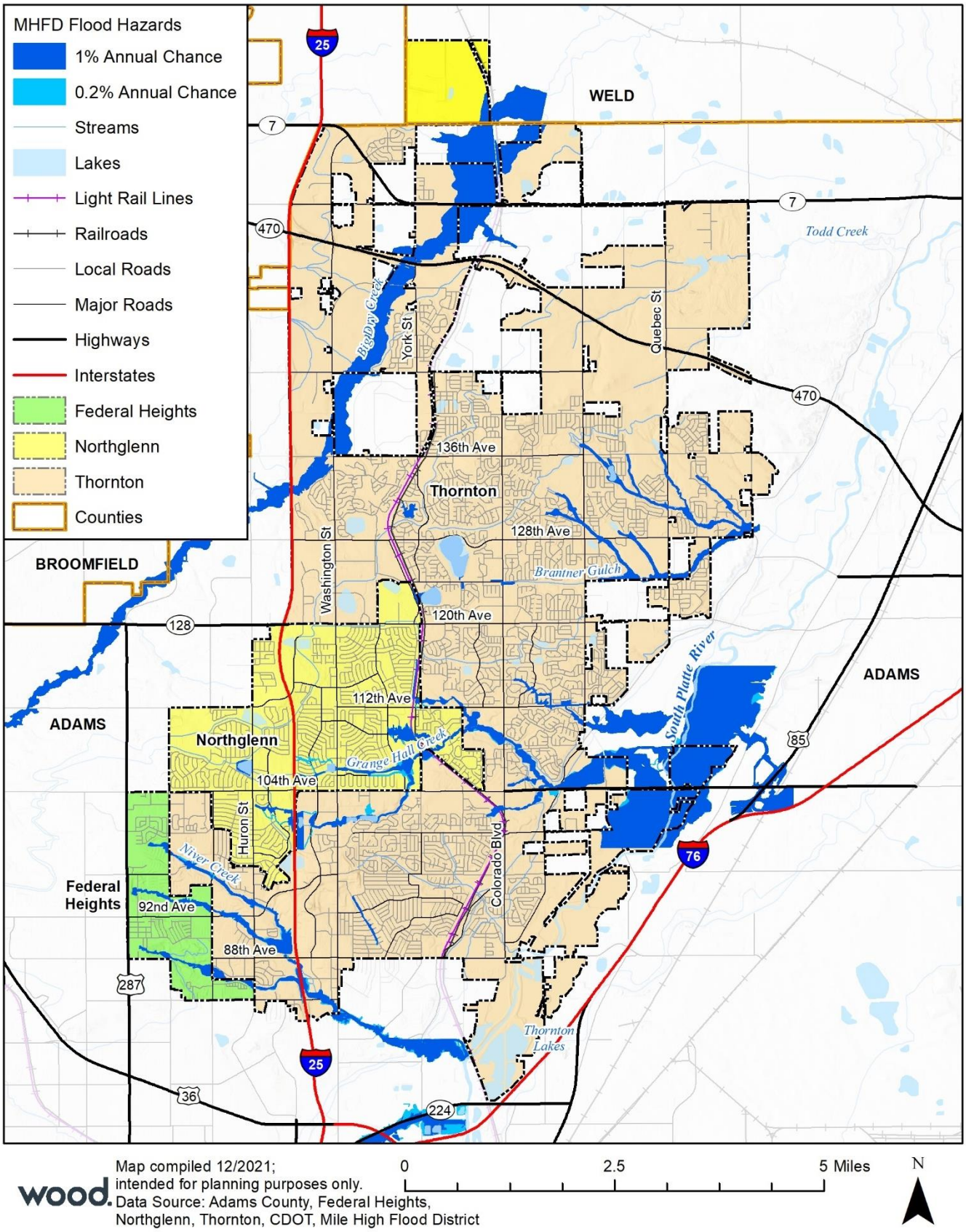


Figure 4-14 Mile High Flood District Flood Mapping in Federal Heights, Thornton, Northglenn



4.8.4 Magnitude/Severity

The magnitude and severity rating is **moderate.**

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. Several factors contribute to the relative vulnerabilities of certain areas in the floodplain. Development, or the presence of people and property in the hazardous areas, is a critical factor in determining vulnerability to flooding. Additional factors that contribute to flood vulnerability range from specific characteristics of the floodplain to characteristics of the structures located within the floodplain. The following is a brief discussion of some of these flood factors which pose risk.

- **Elevation**: The lowest possible point where floodwaters may enter a structure is the most significant factor contributing to its vulnerability to damage, due to the higher likelihood that it will come into contact with water for a prolonged amount of time.
- **Flood depth**: The greater the depth of flooding, the higher the potential for significant damages due to larger availability of flooding waters.
- **Flood duration:** The longer duration of time that floodwaters are in contact with building components, such as structural members, interior finishes, and mechanical equipment, the greater the potential for damage.
- **Velocity**: Flowing water exerts forces on the structural members of a building, increasing the likelihood of significant damage (e.g., such as scouring).
- **Construction type**: Certain types of construction and materials are more resistant to the effects of floodwaters than others. Typically, masonry buildings, constructed of brick or concrete blocks, are the most resistant to damages simply because masonry materials can be in contact with limited depths of flooding without sustaining significant damage. Wood frame structures are more susceptible to damage because the construction materials used are easily damaged when inundated with water.

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

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

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

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

Based on the information in this hazard profile, the magnitude/severity of flooding is limited; even during a 500-year event, there would be only minor structural damage.

4.8.5 Probability of Future Occurrences

Flash flooding has the potential to occur throughout the planning area, including but not limited to the mapped floodplains. While NCEI data only shows four recorded floods in the last 20 years, the HMPC reported that minor flooding occurs happens regularly in the planning area. The probability of future flooding is **likely**.

4.8.6 Climate Change Considerations

In addition to increasing drought and wildland fire potential (and therefore increasing runoff), climate change has the potential to intensify rain events and storms in the Colorado region. According to the NOAA, there is generally more rain and snow falling in the Northern Hemisphere and precipitation has increased by about 5% over the last century. An increase in precipitation alone is not immediately alarming, but "factors such as precipitation intensity, soil moisture and snow conditions, and basin topography are also important in determining the occurrence and severity of flooding." As with temperature, it is the extremes that matter most with regard to rainfall. According to Robert Hanson, author of The Thinking Person's Guide to Climate Change, "Data shows a clear ramp up in precipitation intensity for the United States, Europe, and several other areas over the last century, especially since the 1970s. When it rains or snows in these places, it now tends to rain or snow harder, over periods ranging from a few hours to several days." The 1997 and 2013 flood events caused widespread infrastructural damage, social instabilities, and changes along the waterways throughout many areas of the state. Drought, precipitation intensity and changes in snowmelt patterns are overarching challenges the planning area will face moving into the future.

Additionally, warmer temperatures in the winters may cause increased precipitation to fall as rain instead of snow in mountain regions of Colorado. This may lead to elevated stream flows and increased flood risk across the state. As climate science and data evolves it will be important for communities in and around the three cities to address how our changing climate will affect how water moves through local streams and regional landscapes.

4.8.7 Vulnerability Assessment

People

Based on the GIS analysis performed, where the FEMA special flood hazard areas were overlaid with the Thornton, Federal Heights, and Northglenn parcel layers to obtain the number of vulnerable residential properties (i.e., those intersecting the hazard layer), the total at-risk population to this hazard was estimated. The total population exposed to flooding hazards was calculated by multiplying the average persons per household value for each participating jurisdiction by the total residential properties (including mobile homes) found to intersect with the flood hazard layers. There are a total of 334 residential buildings in the 1% flood hazard area; 180 of those are mobile homes. This assessment estimates that 990 people (0.1% of total population) reside within the 1% flood hazard area. An additional 642 people live in the 0.2% flood hazard area. For more details, refer to Table 4-28 and Table 4-29.

The impacts of flooding on vulnerable populations can be more severe. Families may have fewer financial resources to prepare for or recover from a flood, and they may be more likely to be uninsured or underinsured. Individuals with disabilities may need more time to evacuate, so evacuation notices will need to be issued as soon as feasible, and communicated by multiple, inclusive methods.

General Property

The type of property damage caused by flood events depends on the depth and velocity of the floodwaters. Faster moving floodwaters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive damage can be caused by basement flooding related to soil saturation from flood events. Seepage into basements is common during flood events. Most flood damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances). Homes in flooded areas can also suffer damage to septic systems and drain fields. In many cases, flood damage to homes renders them uninhabitable.

Vulnerability to flooding was determined by summing potential losses to improved parcels in GIS, by using the latest FEMA NFHL data along with the city(s) parcel layer the provided by the Assessor's Office. FEMA's NFHL data

depicts the 1% annual chance and the 0.2% annual chance flood events. Flood zones A, AE, and AO are variations of the 1% annual chance event and were included in the analysis due to being present in the planning area. The "Shaded Zone X" along with the subtype 0.2% annual chance hazard zone were used to represent the 500-year flood event.

GIS was used to create a centroid, or point, representing the center of each parcel polygon. Only parcels with improvement values greater than zero were used in the analysis; this assumes that improved parcels have a structure of some type. The FEMA flood zones were overlaid in GIS on the parcel centroid data to identify structures that would likely be inundated during a 1% annual chance or 0.2% annual chance flood event. Property improvement values for the points were based on the assessor's parcel data and summed by parcel type and jurisdiction across the cities, along with content values and total values.

Based on these results, there are 420 buildings in the 1% annual chance flood zone, 334 of which (80%) are residential buildings. The total parcel exposure value vulnerable to the 1% annual chance flood is over $71 million.

As noted above, the Mile High Flood District (MHFD) has conducted more recent mapping studies in the planning area (see Figure 4-14). While these maps are not regulatory, the HMPC felt they capture a more accurate picture of the flood risk in the area. Analysis of the MHFD mapping in shown below in Table 4-30 and Table 4-31. Note that the Thornton-owned parcels in Larimer and Weld Counties were not mapped by MHFD, as those counties are outside the flood district.

Table 4-28 Properties Exposed to FEMA 1% Annual Chance Flooding

Jurisdiction	Property Type	Improved Parcels	Building Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Federal Heights	Exempt	1	3	$415,001	$415,001	$830,002	$207,501	
	Mobile Home	6	170	$11,815,024	$5,907,512	$17,722,536	$4,430,634	503
	Total	**7**	**173**	**$12,230,025**	**$6,322,513**	**$18,552,538**	**$4,638,135**	**503**
Northglenn	Agricultural	3	4	$940,303	$940,303	$1,880,606	$470,152	
	Commercial	2	3	$4,096,188	$4,096,188	$8,192,376	$2,048,094	
	Exempt	2	3	$1,045,540	$1,045,540	$2,091,080	$522,770	
	Industrial	2	2	$7,946,215	$11,919,323	$19,865,538	$4,966,384	
	Residential	24	38	$39,967,932	$19,983,966	$59,951,898	$14,987,975	110
	Total	**33**	**46**	**$53,055,875**	**$37,045,017**	**$90,100,892**	**$22,525,223**	**110**
Thornton	Agricultural	2	6	$305,936	$305,936	$611,872	$152,968	
	Commercial	7	7	$36,366,567	$36,366,567	$72,733,134	$18,183,284	
	Exempt	7	7	$15,814,636	$15,814,636	$31,629,272	$7,907,318	
	Mobile Home	7	10	$80,040	$40,020	$120,060	$30,015	30
	Residential	29	38	$8,433,442	$4,216,721	$12,650,163	$3,162,541	114
	Total	**52**	**68**	**$61,000,621**	**$56,743,880**	**$117,744,501**	**$29,436,125**	**144**
Thornton Growth Areas	Agricultural	7	16	$2,650,499	$2,650,499	$5,300,998	$1,325,250	
	Exempt	3	29	$10,326,464	$10,326,464	$20,652,928	$5,163,232	
	Residential	44	78	$19,874,652	$9,937,326	$29,811,978	$7,452,995	233
	Total	**54**	**123**	**$32,851,615**	**$22,914,289**	**$55,765,904**	**$13,941,476**	**233**
Thornton-Owned Properties	Larimer - Exempt	2	2	$102,400	$102,400	$204,800	$51,200	
	Weld - Exempt	4	4	$240,188	$240,188	$480,376	$120,094	
	Total	**6**	**6**	**$342,588**	**$342,588**	**$685,176**	**$171,294**	**0**
Grand Total		**152**	**420**	**$160,421,027**	**$124,308,590**	**$284,729,617**	**$71,182,404**	**420**

Source: Wood Analysis of Adams and Weld County and NFHL data

Table 4-29 Properties Exposed to FEMA 0.2% Annual Chance Flooding

Jurisdiction	Property Type	Improved Parcels	Building Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Federal Heights	None	0	0	0	0	0	0	0
Northglenn	Commercial	2	2	$6,536,105	$6,536,105	$13,072,210	$3,268,053	
	Exempt	4	5	$22,974,360	$22,974,360	$45,948,720	$11,487,180	
	Residential	73	81	$22,429,353	$11,214,677	$33,644,030	$8,411,007	235
	Total	**79**	**88**	**$51,939,818**	**$40,725,142**	**$92,664,960**	**$23,166,240**	**235**
Thornton	Commercial	1	1	$24,243,429	$24,243,429	$48,486,858	$12,121,715	
	Exempt	3	3	$14,732,802	$14,732,802	$29,465,604	$7,366,401	
	Residential	128	132	$203,469,379	$101,734,690	$305,204,069	$76,301,017	395
	Total	**132**	**136**	**$242,445,610**	**$140,710,921**	**$383,156,531**	**$95,789,133**	**395**
Thornton Growth Areas	Agricultural	1	1	$156,356	$156,356	$312,712	$78,178	
	Exempt	1	2	$230,287	$230,287	$460,574	$115,144	
	Residential	3	4	$1,525,243	$762,622	$2,287,865	$571,966	12
	Total	**5**	**7**	**$1,911,886**	**$1,149,265**	**$3,061,151**	**$765,288**	**12**
Thornton Properties	Larimer - Exempt	1	1	$107,400	$107,400	$214,800	$53,700	
	Total	**1**	**1**	**$107,400**	**$107,400**	**$214,800**	**$53,700**	**0**
Grand Total		**217**	**232**	**$296,404,714**	**$182,692,728**	**$479,097,442**	**$119,774,361**	**642**

Source: Wood Analysis of Adams and Weld County and NFHL data

Table 4-30 Properties Exposed to MHFD 1% Annual Chance Flooding

Jurisdiction	Property Type	Improved Parcels	Building Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Federal Heights	Exempt	1	1	$2,506	$2,506	$5,012	$1,253	
	Mobile Home	6	157	$10,706,456	$5,353,228	$16,059,684	$4,014,921	465
	Total	**7**	**158**	**$10,708,962**	**$5,355,734**	**$16,064,696**	**$4,016,174**	**465**
Northglenn	Commercial	1	1	$2,249,596	$2,249,596	$4,499,192	$1,124,798	
	Exempt	2	2	$1,045,540	$1,045,540	$2,091,080	$522,770	
	Industrial	1	1	$2,839,965	$4,259,948	$7,099,913	$1,774,978	
	Residential	6	9	$2,112,639	$1,056,320	$3,168,959	$792,240	26
	Total	**10**	**13**	**$8,247,740**	**$8,611,403**	**$16,859,143**	**$4,214,786**	**26**
Thornton	Agricultural	2	5	$305,936	$305,936	$611,872	$152,968	
	Commercial	7	7	$36,144,670	$36,144,670	$72,289,340	$18,072,335	
	Exempt	3	3	$1,614,889	$1,614,889	$3,229,778	$807,445	
	Mobile Home	4	33	$251,028	$125,514	$376,542	$94,136	99
	Residential	159	161	$54,717,093	$27,358,547	$82,075,640	$20,518,910	481
	Total	**175**	**209**	**$93,033,616**	**$65,549,556**	**$158,583,172**	**$39,645,793**	**580**
Thornton Growth Areas	Agricultural	4	11	$800,204	$800,204	$1,600,408	$400,102	
	Exempt	1	1	$404,087	$404,087	$808,174	$202,044	
	Residential	19	35	$9,926,876	$4,963,438	$14,890,314	$3,722,579	105
	Total	24	47	$11,131,167	$6,167,729	$17,298,896	$4,324,724	105
Grand Total		**216**	**427**	**$123,121,485**	**$85,684,422**	**$208.805.907**	**$52,201,477**	**1,176**

Source: Wood Analysis of Adams County and MHFD data

Table 4-31 Properties Exposed to MHFD 0.2% Annual Chance Flooding

Jurisdiction	Property Type	Improved Parcels	Building Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Federal Heights	Mobile Home	4	24	$1,599,648	$799,824	$2,399,472	$599,868	71
	Total	**4**	**24**	**$1,599,648**	**$799,824**	**$2,399,472**	**$599,868**	**71**
Northglenn	Exempt	1	1	$144,592	$144,592	$289,184	$72,296	
	Residential	10	11	$2,607,295	$1,303,648	$3,910,943	$977,736	32
	Total	**11**	**12**	**$2,751,887**	**$1,448,240**	**$4,200,127**	**$1,050,032**	**32**
Thornton	Commercial	1	1	$31,394	$31,394	$62,788	$15,697	
	Mobile Home	2	18	$141,048	$70,524	$211,572	$52,893	54
	Residential	27	28	$117,448,175	$58,724,088	$176,172,263	$44,043,066	84
	Total	**30**	**47**	**$117,620,617**	**$58,826,006**	**$176,446,623**	**$44,111,656**	**138**
Grand Total		**45**	**83**	**$121,972,152**	**$61,074,070**	**$183,046,222**	**$45,761,556**	**241**

Source: Wood Analysis of Adams County and MHFD data

National Flood Insurance Program (NFIP)

The Cities of Thornton, Federal Heights, and Northglenn participate in the National Flood Insurance Program (NFIP) and have been mapped for flood hazards. Details of jurisdiction participation status are shown in the table below, which is repeated from Section 3.8.

Table 4-32 Communities Participating in the FEMA NFIP

CID	Community	Initial FIRM Identified	Current Effective Map Date	Policies in Force	Total Coverage	# of Claims Paid	Total Losses Paid
080240	Federal Heights	04/15/1986	12/02/2021	8	$903,000	6	$21,217
080257	Northglenn	09/15/1978	12/02/2021	15	$5,450,000	4	$3,152
080007	Thornton	06/15/1978	12/2/2021, 1/20/2016, & 3/5/2007	50	$13,476,900	11	$33,770

Source: FEMA

Another measure of flood risk is the number of NFIP-insured properties, and how many losses those properties have experienced. As shown in the above Table, Thornton has 50 NFIP policies worth $13 million and has had $33,770 worth of losses since 1978; Northglenn has 15 policies worth $5 million but has only $3,152 in losses since 1978; and Federal Heights has only 8 properties worth less than $1 million but has experienced $21,217 in losses since 1986.

Repetitive Losses

In addition to the above analysis of total flood insurance coverage and claims, repetitive loss data was examined to determine the number of repetitive losses from flooding and the extent to which these properties are insured. A **Repetitive Loss (RL)** property is defined as 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. A RL property may or may not be currently insured by the NFIP. **Severe repetitive loss properties (SRL)** are those for which the program has either made at least four payments of more than $5,000 or at least two building- only payments that exceeded the value of the property.

As of January 2022, there is one RL property in the planning area, located in Thornton. It is a single family residential structure and has suffered two flood losses: one during the September 2013 floods and again during the May 2015 flooding. There are no severe repetitive loss (SRL) properties in the planning area.

Community Rating System (CRS) Program

The Community Rating System (CRS) program is a voluntary program for NFIP participating communities. The goals of the CRS are to reduce flood damages to insurable property, to strengthen and support the insurance aspects of the NFIP, and to encourage a comprehensive approach to floodplain management.

The CRS was developed to provide incentives in the form of insurance premium discounts to communities that go above and beyond the minimum floodplain management requirements and develop extra measures to reduce flood risk. There are 10 CRS classes, and the classification determines the insurance premium discount for policy holders. The discounts range from 5% to a maximum of 45%.

As discussed in Section 3.8, the City of Thornton has participated in CRS since 1994 and currently holds a Class 6 CRS rating. The Cities of Federal Heights and Northglenn do not currently participate in CRS.

Table 4-33 CRS Premium Discounts

CRS Class	% Discount	Federal Heights Annual Savings	Northglenn Annual Savings	Thornton Annual Savings
1	45%	$1,073	$8,860	$15,383
2	40%	$954	$7,890	$13,685
3	35%	$834	$6,919	$11,988
4	30%	$715	$5,949	$10,291
5	25%	$596	$4,978	$8,594
6	20%	$477	$4,008	**$6,897***
7	15%	$358	$2,974	$5,145
8	10%	$238	$2,004	$3,448
9	5%	$119	$1,034	$1,751
10	0%	$0	$0	$0

Source: FEMA Community Information Systems
* Thornton's current CRS rating

Critical Facilities and Infrastructure

The impacts of floodwater on critical facilities such as police and fire stations, health facilities, and water or wastewater treatment facilities among others can greatly increase the overall effect of a flood event on a community (e.g., if critical potable facilities are impacted). In general, most of these facilities are located in areas with lower risk to flooding due to recent requirements for developers to consider hazard risks in their plans. However, the GIS analysis performed indicates several critical facilities were found to be vulnerable to 1% and 0.2% annual flood hazard areas, as listed in Table 4-34 and Table 4-35.

A total of 85 facilities are in a 1% annual chance flood area. As shown in the tables below the greatest number of facilities in the 1% annual chance flood area across the city are transportation critical facilities such as bridges. With the second largest number of facilities that are deemed critical being food, water, and shelter with fourteen total and Hazmat facilities being a close third with fourteen total.

Table 4-34 Critical Facilities within the FEMA 1% Annual Chance Flood Hazard Zone

Critical Facilities	Federal Heights	Northglenn	Thornton	Thornton Growth	Total
Communications	-	-	2	4	**6**
Energy	-	-	-	-	**-**
Food, Water, Shelter	1	-	9	6	**16**
Hazardous Material	-	2	8	4	**14**
Health and Medical	-	2	-	-	**2**
Safety and Security	-	-	3	8	**11**
Transportation	-	-	29	7	**36**
Total	**1**	**4**	**51**	**29**	**85**

Source: Wood Analysis of data from the Cities of Federal Heights, Northglenn, & Thornton, and NFHL

Thirteen critical facilities are in the 0.2% annual flood hazard area. The largest total of facilities in the 0.2% floodplain is Hazmat Facilities with four located in the Thornton. Although the 0.2% annual flood hazard areas are just a fraction of a percentage in which a specific area may flood. More intense stormwater and flooding events are taking place and floodplain and mitigation activities should take place to build as safe and strong in these areas as possible.

Table 4-35 Critical Facilities within the FEMA 0.2% Annual Chance Flood Hazard Zone

Critical Facilities	Federal Heights	Northglenn	Thornton	Thornton Growth	Total
Communications	-	1	1	1	**3**

Critical Facilities	Federal Heights	Northglenn	Thornton	Thornton Growth	Total
Energy	-	-	-	-	**-**
Food, Water, Shelter	-	-	-	-	**-**
Hazardous Material	-	-	2	2	**4**
Health and Medical	-	2	-	-	**2**
Safety and Security	-	2	-	-	**2**
Transportation	-	-	2	-	**2**
Total	**-**	**5**	**5**	**3**	**13**

Source: Wood Analysis of data from the Cities of Federal Heights, Northglenn, & Thornton, and NFHL

Public buildings are of particular importance during flood events because they house critical assets for government response and recovery activities. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Loss of power and communications can be expected. Drinking water and wastewater treatment facilities may be temporarily out of operation. Businesses and people may face the threat of explosions and fires caused by leaking gas lines, along with the possibility of being electrocuted by downed power lines.

Figure 4-15 2013 Flooding in Thornton



Source: City of Thornton

Economy

Flooding can have a major economic impact on the economy, including indirect losses such as business interruption, lost wages, reduced tourism and visitation, and other downtime costs. Flood events can cut off customer access to a business as well as close a business for repairs or permanently. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Historic, Cultural and Natural Resources

Natural areas within the floodplain often benefit from periodic flooding as a naturally recurring phenomenon. These natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters. Natural resources are generally resistant to flooding, except where natural landscapes and soil compositions have been altered for human development or after periods of previous disasters such as drought and fire. Wetlands, for example, exist because of natural flooding incidents. Areas that are no longer wetlands may suffer from oversaturation of water, as will areas that are particularly impacted by drought.

Domestic and wild animals forced out of their homes and brought into contact with humans by floodwaters can also pose a threat. In rural areas, property damage caused by flooding can be devastating to ranchers and farmers. When flooding occurs during the growing season, farmers can suffer widespread crop loss. Stock growers may lose livestock if they are unable to find safety from rising floodwaters. Flooding may also cause damage to pastureland, fences, barns, and outbuildings.

Mitigation against flood events is accomplished through sensible floodplain management and regulations as well as identifying flood prone areas, tributary watersheds that experience instability or sediment loading problems, and channel instability hazards. This involves strategies to modify flooding and to modify infrastructure to decrease the likelihood of damage.

Flood was identified as a high hazard for all three cities within the planning area, due to its high frequency, large geographic extent, and high public interest. Additional information on potential losses can be found in the community profiles sections of this report (Appendices A, B, and C).

Future Land Use and Development

The jurisdictions of Thornton, Federal Heights and Northglenn communities oversee future growth trends. Each of the three municipalities are participants in the NFIP and have incorporated flood damage prevention codes in response to its requirements. Thornton participates in the CRS program and is committed to maintaining its good standing under the NFIP through initiatives identified in this plan.

Flooding in these areas can be considered imminent given the development and impervious runoff associated with this growth. Flash floods are always a prevalent issue and should be monitored and mitigated where possible.

4.8.8 Jurisdictional Differences

Federal Heights has the greatest number of properties and building parcels subjected to the annual 1% chance of flooding with 173 buildings total, 170 of which are mobile homes. 503 people are at risk, although the low value of the mobile homes means that the estimated property losses are only $4,638,135.

Thornton has the highest estimated losses at over $29 million for 68 structures, 10 of which are mobile homes. 144 people are at risk in the City. Thornton's growth area includes another 233 people and 123 structures, with almost $14 million in estimated losses.

Northglenn has 110 people and 46 buildings in the 1% flood area, with estimated losses of $22 million.

All three Cities ranked flood as high significance in the 2017 HMP, and agreed that ranking is still valid for the 2023 update.

4.8.9 Risk Summary

- The overall significance ratings for flood in Thornton, Federal Heights, and Northglenn is **high**.

- According to NCEI, there have been ten flood and flash flood events in the planning area in the last 23 years. There is a 50% chance of occurrence in any given year.
- Historically, stormwater and street flooding have been the more significant types of flooding to affect the three cities.
- 503 people reside within the 1% annual chance flood areas for Federal Heights, 110 people in Northglenn and 144 in Thornton.
- 235 reside within the 0.2% annual chance area for Northglenn and 395 are in Thornton.
- Within the 1% annual chance flood area, there is a total property exposure of $285 million for the entire planning area with a combined loss estimate of $77 million, as well as 85 critical facilities. Within the 0.2% annual chance flood areas there is an additional property exposure of $479 million and a total loss estimate of $120 million, and 13 critical facilities.

4.9 Ground and Surface Water Supply Contamination

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Critical	Occasional	**Medium**
Northglenn	Extensive	Critical	Occasional	**Medium**
Thornton	Extensive	Critical	Occasional	**Medium**

4.9.1 Description

Water has always been a precious resource in the state of Colorado, which is the seventh driest state in the U.S. despite having eight river basons. As such, Colorado has a long-established water rights structure known as the "Prior Appropriation System", which establishes water usage rights and also known as the local Settler's system of "first in time, first in right", whereby the individual who first appropriates water and puts it to beneficial use acquires a vested right to continue to divert and use that quantity of water.

The cities of Thornton, Northglenn, and Federal Heights all get their water from snowmelt originating in the Rocky Mountains before flowing into Standley Lake and other reservoirs where it is stored for use. Additionally, the city of Federal Heights draws approximately 1% of its water supply from a well drawing groundwater from the Arapahoe aquifer. Sources of drinking water are subject to contamination and require appropriate treatment before municipal use. Contamination of drinking water can occur both in the source water, in streams and rivers on the way to storage, as well as in the distribution system after the water has already been treated.

According to the water quality reports for each of the 3 cities, the sources of drinking water (both tap water and bottled water) such as rivers, lakes, and streams, contain naturally occurring minerals, including radioactive material, that are not completely removed at the water treatment plant and can pose a human health risk if present at a concentration above the safe levels set by the EPA. Water contamination can take many forms, such as naturally occurring chemicals and minerals like arsenic, radon or uranium, fertilizers, pesticides, agricultural runoff, pollution, hazardous materials spills, wastewater overflows, and biological contaminants. There is also the risk for contamination in a deliberate manner such as sabotage of the municipal water supply, cyber-attack, or terrorism.

A security assessment of Standley Lake conducted for the Standley Lake Water Quality Intergovernmental Agreement in 2022 identified several potential threats to water quality in the lake, to include:

- Wastewater;
- Nutrients;
- Stormwater;
- Land Use;
- Road Salts;
- Significant industrial & commercial facilities;
- Aquatic nuisance species;
- Extreme events (fire, drought, flood);
- Transportation corridors;
- Mine blowouts or treatment failures;
- Equestrian activities and properties;
- Oil and gas development including fracking;
- Agriculture;
- Ecoterrorism/vandalism.

4.9.2 Previous Occurrences

Water supply contaminations can occur quite frequently in Colorado and the U.S. According to the CDC, the following are the top ten most commonly occurring causes of contaminant outbreaks in the country from 1971 (when monitoring began more consistently with the passage of the Clean Water Act) to 2010:

1. Giardia
2. Legionella
3. Norovirus
4. Shigella
5. Campylobacter
6. Copper
7. Salmonella
8. Hepatitis A
9. Cryptosporidium
10. E. coli/excess fluoride (tie)

Fecal coliform and toxic algae blooms are also common occurrences in lakes and reservoirs where drinking water is stored, which can lead to numerous kinds of bacterial outbreaks such as those listed above. Most such outbreaks are easily treated or otherwise contained at the local level. One notable event in Colorado occurred in the City of Alamosa in 2008 with a salmonella bacteria outbreak. While there are several possible causes of this outbreak, the conclusion was that it was caused by an animal source of fecal contamination which entered the Weber Reservoir, where the City's water was stored. From there the outbreak of salmonella spread through the entire water system and resulted in hundreds of reported illnesses and one death. Thornton has experienced toxic algae blooms over the past few years and has had to take steps in treatment to obviate taste and odor and potential toxicity.

Industrial activities can also lead to contamination of water supplies, through discharge of wastewater or chemicals or accidental spills of contaminated materials. One of the most notable recent instances of this in Colorado is the 2015 Gold King Mine incident near Silverton, Colorado. This event occurred during remediation efforts at the closed Gold King Mine when accidental damage to a plug holding water inside of the mine resulted in the release of three million gallons of mine wastewater into the Animas River. The water was filled with heavy metals like cadmium and lead, as well as arsenic, beryllium, zinc, iron, and copper, which turned the Animas River yellow temporarily. The long-term impacts of the Gold King Mine incident are still unknown; however, impacts will continue to be felt throughout the San Juan River watershed.

Water supply contaminations have also previously occurred in the U.S. from deliberate attacks. In 2021 a water treatment plant in Oldsmar, Florida was remotely accessed by hackers who increased the concentration of sodium hydroxide in the water supply from 100 parts per million to over 11,000 parts per million. The attack was caught, and the water contamination returned to normal levels before it could reach any homes, and as such there were no deaths or injuries due to the attack. However, this incident highlighted the danger that exists to utilities from cyber and terrorist incidents.

4.9.3 Location

As mentioned above, contamination of the water supply can potentially occur at any point along the water cycle, from the source point to storage basins to municipal distribution systems even after treatment has occurred. The HMPC expressed concern about the surface water sources along I-76, US-85, and 104th Ave, which could be impacted by a hazardous materials spill or by deliberate dumping of chemicals. The potential geographic extent of the hazard is **extensive**.

4.9.4 Magnitude/Severity

The magnitude and severity of a water supply contamination depends greatly on the extent of the contamination, as well as the extent relative to the water distribution system. Contamination could result in small scale event with remediation that is handled by regular water treatment, or it could result in a widespread outage of the water utility infrastructure in the planning area while cleanup is addressed. Based on other incidents in Colorado and around the country, the potential impacts could be **critical**.

4.9.5 Probability of Future Occurrences

Each city under the requirement of the EPA conducts a water quality report annually to examine levels of various contaminants and ensure they are under the allowable concentrations permitted by the Clean Water Act. Given the nature of this hazard, it can be expected that contaminations of the planning area's

water supply will occur at some point in the water supply's life cycle, likely on an annual basis. Most of these instances will be addressed by normal water treatment practices. The likelihood of a significant contamination that could bypass or surpass the capacity of the planning area's water treatment capabilities in a manner that could threaten public health and safety is far less likely, however. Given the relatively few instances of major incidents, the probability of this hazard is assessed to be **occasional**.

4.9.6 Climate Change Considerations

According to the EPA, climate change might have several impacts on water quality in the coming years. One such example is the improving conditions for toxic algal blooms that may accompany warmer weather. Climatic shifts such as warming water temperature, changes in salinity, higher carbon dioxide levels, and changes in rainfall all could encourage more frequent and sever algal blooms. Warmer water temperatures prevent water from mixing more within a body of water, leading to stagnation which allows algae to grow thicker and faster. As algal blooms grow thicker, they can also absorb more sunlight, further increasing the water temperature and promoting more blooms.

An increase in extreme rainfall events, which may occur more frequently with a changing climate, can also lead to increased nutrient and surface contaminant runoff into waterbodies.

4.9.7 Vulnerability Assessment

People

People will be the most vulnerable to water supply contaminations, with immediate impacts such as illness or injury from contaminated water. Giardia, lead poisoning and other heavy metal contaminants, and bacterial or viral infections can cause serious illness in the population, potentially widespread depending on the degree of the contamination and the length of time before it is addressed. For example, in the Alamosa incident the population of Alamosa at the time of the outbreak was about 8,900 people. Epidemiological estimates suggest that up to 1,300 people, or approximately 15% of the total population, became ill. An occurrence of similar scale in Thornton, Federal Heights, or Northglenn could have staggering impacts on the local population and put significant strain on the healthcare system.

General Property

Damage to private property resulting from water contamination is unlikely.

Critical Facilities and Infrastructure

As water and water distribution systems are in themselves critical infrastructure, any contamination of this resource will have negative impacts on critical facilities and infrastructure. Municipalities may be forced to procure water from a new source if severe contamination has occurred at the source point, until levels of contaminants are brought under control. Significant costs may occur if contamination is so severe or pervasive that repairs or replacement of the water treatment or distribution system infrastructure is needed. One of the most notorious examples of this is the Flint Water Crisis in Michigan. The City of Flint switched its water source from its longtime sources in Lake Huron and the Detroit River to the Flint River in an effort to save costs. Due to the city's aged water infrastructure and the highly corrosive nature of the Flint River, which itself had been the site of contamination for decades, Flint saw a pervasive and devastating impact to the water supply with lead leaching from pipes, coliform bacteria, and an outbreak of legionnaire's disease all occurring throughout this time period. This resulted in an extensive city-wide lead service pipe replacement effort, costing an estimated $60 million and 15 years to complete.

Economy

A large-scale contamination of the water supply could result in large economic costs in terms of cleanup and remediation. There could also be cost burdens to residents if they are forced to buy bottled water, or to the cities if they must provide bottled water, which occurred for years during the Flint Water Crisis.

Historic, Cultural, and Natural Resources

Contamination of the water supply can lead to severe environmental degradation. During the 2015 Gold King Mine incident, the Animas River visibly changed to an orange color due to the high concentrations of heavy metals in the water. These contaminants can settle in the sediments in the river and have severe negative impacts on the health of vegetation and aquatic life, in addition to users of the of the water supply. Contamination such as this can linger in the environment at elevated levels for decades.

Land Use and Development

As the population in the planning area grows, so does the demand for water and the strain on it as a limited resource in the state of Colorado. Additionally, as there is more intensive growth and development and a greater density of people, there is arguably a greater chance for water contamination to occur through pollution, runoff, and emissions that typically accompany cities.

4.9.8 Jurisdictional Differences

As each of the three cities in the planning area all draw their water from Standley Lake, the risk for contamination does not vary greatly between the cities. Each city has separated distribution systems, so it is possible that a contamination incident could occur affecting only one of the three cities, however this would likely be the result of sabotage or terrorism. Additionally, the small portion of Federal Heights water supply which is drawn from the Arapahoe aquifer could theoretically become contaminated independent of the rest of the water supply.

The risk of ground and surface water supply contamination was not profiled in the 2017 HMP.

4.9.9 Risk Summary

The overall significance of ground and surface water supply contamination in the Cities of Thornton, Federal Heights and Northglenn is **medium**. These natural contamination incidents occur somewhat frequently, although the possibility of a larger scale contamination affecting systems within the three cities is difficult to quantify.

- Water supply contamination can result in illness and if left unaddressed in severe cases, chronic illnesses, or death.
- There are many natural causes of water supply contamination which, are typically addressed by standard water treatment practices. Contamination could also be the result of a terrorist or cyber-attack.
- Injuries and fatalities to people are unlikely, unless in a widescale incident goes unnoticed for a period of time.
- The vast majority of contamination incidents do not affect property.
- Economic impacts from a water supply contamination can be debilitating, sometimes costing local governments millions of dollars.
- Related Hazards: cyber-attack, hazardous materials, wildfire.

4.10 Hazardous Materials

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Significant	Moderate	Likely	**Medium**
Northglenn	Significant	Moderate	Likely	**Medium**
Thornton	Significant	Moderate	Likely	**Medium**

4.10.1 Description

Generally, a hazardous material is a substance or combination of substances which, because of quantity, concentration, or physical, chemical, or infectious characteristics, may either cause or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness. Hazardous materials may also pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, disposed of, or otherwise managed.

The U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) all have responsibilities relating to the transportation, storage, and use of hazardous materials and waste. The Right to Know Network maintained by the U.S. Coast Guard's National Response Center (NRC) is a primary source of information on the use and storage of hazardous materials, as well as data regarding spills and releases. In Colorado, the manufacture, use, storage, and transportation of hazardous materials is regulated by the Colorado Department of Public Health and the Environment (CDPHE). Hazardous materials carriers are subject to Colorado Public Utility Commission (PUC) registration and insurance requirements. Colorado statutes require that any person transporting hazardous materials that require placarding to obtain a Hazardous Materials Permit from the Public Utilities Commission. Safety oversight is the jurisdiction of the Colorado State Patrol. The U.S. Department of Transportation divides Hazardous materials into the following classes:

1. Explosives
2. Compressed gases
3. Flammable and combustible liquids
4. Flammable solids
5. Oxidizers and organic peroxides
6. Toxic materials
7. Radioactive materials
8. Corrosive materials
9. Miscellaneous

It is also common to see hazardous materials releases result as escalating incidents from other hazard incidents such as floods and wildfires. The release of hazardous materials can greatly complicate or even eclipse the response to the natural hazards disaster that caused the spill.

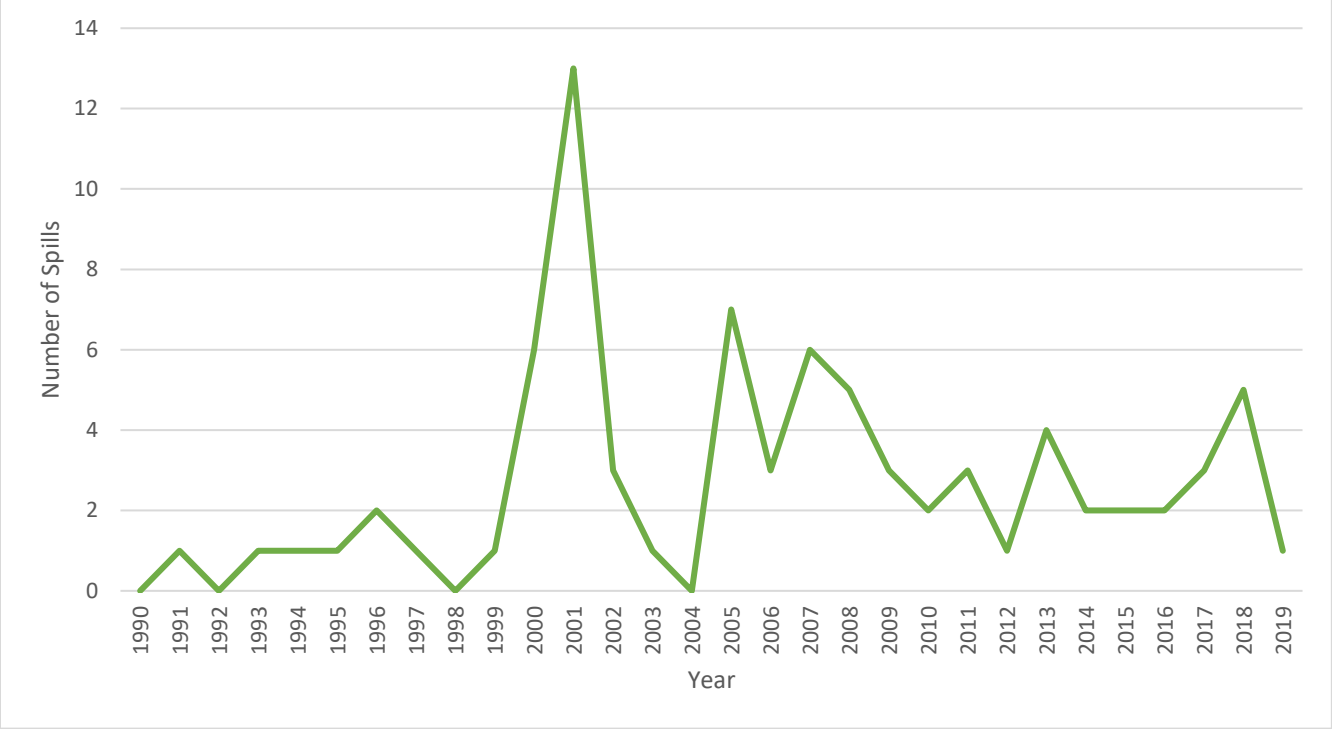
4.10.2 Previous Occurrences

Hazardous materials incidents occur regularly in all three cities and the counties they are located in. The 2018 Colorado State Hazard Mitigation Plan notes that Adams County has more transportation and fixed facility hazardous materials releases than any other Colorado county (excluding oil and gas well spills).

Statistics from the National Response Center (NRC), which serves as the primary national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the environment anywhere in the United States and its territories, indicate that from 1991 through 2019, 80 hazardous materials incidents were reported in Thornton, Federal Heights, and Northglenn. This translates to an average of 2.9 incidents per year. This number almost certainly excludes a number of very small spills that were not reported to the NRC. The trend over the last 28 years shows fewer incidents in the 1990s (average of one incident per year), with the number of incidents more than doubling during the 2000s (average of four incidents per year), followed by a slight decline during the 2010s (average of three incidents per year).

Of those 80 incidents, only nine resulted in any significant impacts. These impacts included one fatality, five injuries, and three evacuations (131 evacuees total); no property damages were reported. It is important to note that the NRC counts all injuries or damages resulting from an accident where hazardous materials were involved, whether or not the injuries or damages were caused by exposure to the hazardous substance. While the one fatality was from a natural gas explosion in Thornton, the majority of the injuries were from the physical impacts of the accident that caused the release, rather from exposure to hazardous materials themselves.

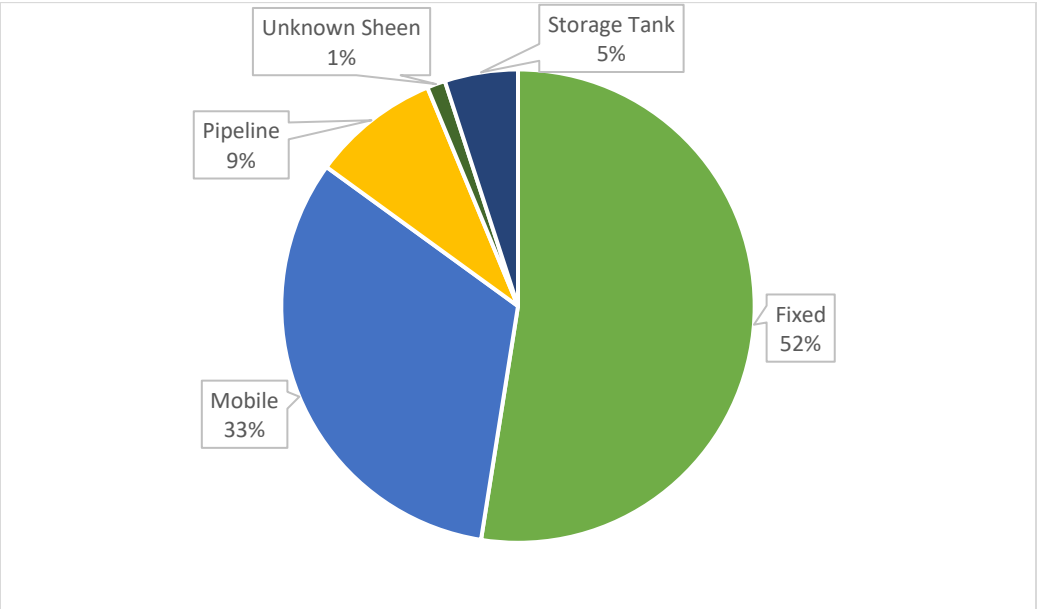
Figure 4-16 Hazardous Materials Incidents in Thornton, Federal Heights, and Northglenn, 1991-2019



Source: National Response Center

Hazardous material incidents in the planning area are most common at fixed sites (52%), while 33% were due to mobile incidents and seven from pipeline incidents (9%) and 5% were from storage tanks. Figure 4-17 shows the breakdown of incidents by type.

Figure 4-17 Hazardous Materials Incidents by Type, 1991-2019



Source: National Response Center

4.10.3 Location

Hazardous materials incidents can occur anywhere hazard materials are stored or transported. This includes designated transportation routes through and nearby the cities and fixed facilities within each of the city limits. Interstate 25, which bisects Northglenn and crosses through Thornton, is a designated route for hauling nuclear and hazardous materials by vehicle. In addition to designated transportation routes through the city, a number of fixed facilities are located in three city area.

Generally, with a fixed facility, the hazards are pre-identified. The U.S. Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 requires industries to report on the storage, use, and releases of hazardous substances to federal, state, and local governments. Facilities in Colorado must submit an emergency and hazardous chemical inventory form (Tier II form) to the Colorado Emergency Planning Commission (CEPC), the Local Emergency Planning Committee (LEPC), and local fire departments annually. Tier II forms provide state and local officials and the public with information on the general hazard types and locations of hazardous chemicals present at facilities during the previous calendar year. The inventory forms require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility. There are 89 Tier II facilities in the planning area, with 49 located in Thornton, five in Northglenn, two in Federal Heights, and an additional 33 in the Thornton Growth Area.

The EPA also requires facilities containing certain extremely hazardous substances to generate Risk Management Plans (RMPs) and resubmit these plans every five years. As of January 2022, there are two RMP facilities in the planning area, one in Thornton and one in Northglenn.

In addition to fixed facilities and the designated transportation routes, there are oil and gas wells and pipelines that are also located in the planning area. According to the Colorado Pipeline Association (CoPA), there are approximately 45,000 miles of pipeline in the State of Colorado that transport natural gas, crude oil, fuel, and other hazardous materials. The Pipeline and Hazardous Materials Safety Administration, National Pipeline Mapping System shows there are gas transmission and hazardous liquid pipelines that pass-through Thornton and Northglenn. According to the 2018 Colorado State Hazard

Mitigation Plan there are over 100,000 active and plugged wells in Colorado. Weld County has the highest number of wells in the state (DHSEM 2018). According to the Colorado Oil & Gas Commission GIS Online, there are no wells in Federal Heights or Northglenn, but there are a number in the northern portion of Thornton and in unincorporated areas of Adams and Weld Counites. Overall, the geographic extent is **significant**.

4.10.4 Magnitude/Severity

Because of the variability of hazardous materials transported across the county, a general extent measure is difficult to determine. As a general rule, any hazmat release is anticipated to have an impact of no more than one mile around the incident site. Specific incident parameters including material released, method of release, time of day, weather patterns and location factor into incident impacts. The impact to life and property from any given release depends primarily on:

- The type and quantity of material released.
- The human act(s) or unintended event(s) necessary to cause the hazard to occur.
- The length of time the hazard is present in the area.
- The tendency of a hazard, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space.
- Characteristics of the location and its physical environment that can either magnify or reduce the effects of a hazard.

Impacts from hazardous materials releases can include:

- Fatalities
- Injuries or health problems
- Evacuations
- Property damage
- Animal fatalities (livestock, fish & wildlife)
- Air pollution
- Surface or ground water pollution/contamination
- Road closures, interruption of commerce and transportation

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident.

The impacts of major hazardous materials incidents are potentially catastrophic, causing multiple deaths, property damage, and/or interruption of essential facilities and service for more than 72 hours. Pipeline accidents and gas explosions account for the majority of deaths and injuries caused directly by hazardous materials nationally. Historically the impact of hazardous materials incidents in the area have been limited; one death and six injuries have been reported in a 28-year period, although as noted previously most of those were likely from the cause of the release rather than from the material itself. Overall, the impact of the vast majority of incidents in the planning area are likely to be **moderate** at most.

4.10.5 Probability of Future Occurrences

Although the planning area experiences 2.9 hazardous materials incidents per year on average, the vast majority of those have little to no impacts beyond the immediate accident scene. Only ten damaging incidents were recorded over the 29-year period of record, which equates to roughly one every three years, which translates to a future probability rating of **likely**.

4.10.6 Climate Change Considerations

There are no known effects of climate induced impacts on human-caused hazards such as hazardous materials incidents.

4.10.7 Vulnerability Assessment

GIS analysis was used to overlay the location of each Tier II facilities with dam inundation layers, wildland urban interface (WUI) intermix layers, expansive soil layers, and 100-year and 500-year floodplain layers. Of the 89 Tier II facilities in the planning area, 49 facilities are vulnerable to at least one hazard (refer to Table 4-36), 35 are vulnerable to multiple hazards and 3 are not located within an identified hazard area. Most Tier II facilities are vulnerable to expansive soil (33 facilities) followed by wildfire (15 facilities).

Table 4-36 Tier II Facilities and Potential Hazard Risk (One Hazard Only)

City	Dam Inundation	Expansive Soil	Floodplain	Wildfire Risk	Total
Federal Heights	0	2	0	0	**2**
Northglenn	0	2	0	0	**2**
Thornton	1	22	0	3	**26**
Thornton Growth Area	0	7	0	12	**19**
Grand Total	**1**	**33**	**0**	**15**	**49**

Source: Wood GIS analysis of CEPC data

People

The public's general vulnerability to hazardous materials incidents depends on the material involved. There are three exposure pathways for a person to come into contact with a hazardous material: inhalation, ingestion, and skin contact. Effects to people can include burns, breathing problems, and contamination. According to the public survey results over 50% of respondents considered hazardous materials incidents a medium concern as a resident of the three cities.

A toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Of the incidents recorded in the NRC database three led to evacuation orders affecting 131 people. There have likely also been a number of shelter in place orders, however those are not captured in the NRC database. Vulnerable populations can be more severely impacted by hazardous materials incidents. People with existing health risks or compromised immune systems could be severely affected by releases of even relatively low-impact materials. Low-income families may be more likely to live in industrial areas or near hazardous materials routes. Individuals with disabilities may need more time to evacuate, so evacuation notices will need to be issued as soon as feasible, and communicated by multiple, inclusive methods. In some scenarios sheltering-in-place may be the safest, most realistic option to minimize impacts to people.

General Property

Impacts on the built environment are dependent on the site of the hazardous materials spill, weather and environmental conditions, and the material itself. Designated hazardous materials routes are designed to bypass large segments of the built environment as possible. Infrastructure located close to fixed facilities and along hazmat transportation routes are especially vulnerable to impacts of hazardous materials, which could include facility damage, clean-up costs, access issues and general interruptions in the ability of the facility to function.

Critical Facilities and Infrastructure

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring communities, or

vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities.

Economy

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and recreationists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant not only for Thornton, Federal Heights, and Northglenn but also for the entire Denver-metro region.

Even small incidents have cleanup and disposal costs, and for a larger scale incident, these could be extensive and protracted. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damages, with clean-ups that can last for years. In Colorado, most of these costs are borne by the

Historic, Cultural and Natural Resources

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant. Specific areas of concern include areas where routes intersect or parallel rivers, and areas that present difficulty of access due to topography.

Land Use and Development

When planning future development, proximity and vulnerability to hazardous materials routes and facilities should be taken into consideration. There are a total of 33 Tier II facilities located in Thornton's Growth Area. Based on the GIS Analysis described above, all facilities except one is located within at least one hazard area. Fixed facilities with hazardous materials are identified and located; the location of these facilities and their potential impacts should factor into future development decisions around the sites.

4.10.8 Jurisdictional Differences

Between 1991 and 2019 there have been 14 hazardous material incidents in Federal Heights. None of these incidents related in casualties or resulted in damages. A majority of past hazardous material incidents in Federal Heights were at fixed sites.

Between 1991 and 2019 there have been 20 hazardous material incidents in Northglenn. None of these incidents related in casualties or resulted in damages. One incident resulted in an evacuation of six people. A majority of past hazardous material incidents in Northglenn were at fixed sites.

Between 1991 and 2019 there have been 46 hazardous material incidents in Thornton. In total, these incidents resulted in five casualties (1 fatality and four injuries). None of the incidents resulted in property damages. A majority of past hazardous material incidents in Thornton were mobile incidents.

The risk of hazardous materials incidents was not profiled in the 2017 HMP.

4.10.9 Risk Summary

- The overall significance of hazardous materials incidents in the planning area is **medium**.
- There were 80 hazmat incidents reported between 1991-2019, an average of 2.9 incidents per year.
- Half of these incidents were at fixed facility sites.
- Only nine incidents resulted in any injuries (5), fatalities (1), or evacuations (131 people total).
- There are 89 Tier II facilities in the planning area, a majority are located in Thornton.
- Related Hazards: Cyber Incident, Terrorism, Dam Failure, Expansive Soil, Mass Transportation Incident, Earthquake, Flood, Ground & Surface Water Supply Contamination, Severe Storms, Tornado, Wildfire

4.11 Mass Transportation Incident: Aviation, Railway, Highway

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Significant	Moderate	Occasional	**Medium**
Northglenn	Significant	Moderate	Occasional	**Medium**
Thornton	Significant	Moderate	Occasional	**Medium**

4.11.1 Description

Thornton, Federal Heights, and Northglenn have unique transportation and infrastructure hazards and vulnerabilities contingent upon many variables. The transportation sector includes aviation, automotive, and rail. Transportation incidents can involve any mode of transportation that directly threatens life, and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services. Incidents involving buses and other high occupancy vehicles could trigger a response that exceeds the normal day-to-day capabilities of response agencies.

What constitutes a "mass" transportation incident has intentionally not been strictly defined to allow for flexibility in analysis. In general, a mass transportation incident is one that produces significant casualties or other significant impacts.

Aviation: While there are no airports in the planning area, the Denver metropolitan area has five airports in total: one commercial large hub airport, three general aviation airports, and one Air Force Base. Denver International Airport (KDEN) is the fifth busiest airport in the US and is the Rocky Mountain region's primary commercial service large hub airport serving approximately 53 million passengers annually. Centennial Airport (KAPA), Rocky Mountain Metropolitan Airport (KBJC), Front Range Airport (KFTG) also serve the Denver metropolitan area and primarily support general aviation and private business aviation. Buckley Space Force Base (formerly Buckley Air Force Base) is located to the east of the planning area and services military air traffic. The main hazards presented by aircraft are mid-air collisions, crashes, or intentional incidents as a result of terrorism.

Automotive: The three cities have a large roadway infrastructure composed of interstates, state highways, municipal surface streets, and private roads. Interstate-25, E-470 and U.S. Route 287 are the three major interstates within the planning area. Due to rising population levels, there has been an increase of traffic congestion on most major roadways within the planning area and the Denver metropolitan area. Minor traffic accidents are a hazard but occur frequently and generally pose little threat to the cities as a whole. However, large multi-vehicle collisions and incidents involving hazardous materials present significantly more hazardous impacts to the cities.

Rail: The metropolitan area has an active railroad system that operates freight, passenger, and commuter lines that both surround and, in some cases, cross through the cities. While rail incidents are not frequent, when they do occur, their impacts are often highly significant especially if a major loss of life occurs or hazardous materials are involved.

4.11.2 Previous Occurrences

Aviation

There have been no reported aviation accidents inside the planning area. On February 20, 2021, Debris from a United Airlines Boeing 777 fell on several neighborhoods in the City and County of Broomfield. The plane was flying from Denver to Honolulu and experienced right-engine failure shortly after takeoff and made an emergency landing at Denver International Airport (DIA) as a result. No one aboard or on the ground was injured as result of the debris falling.

Automotive

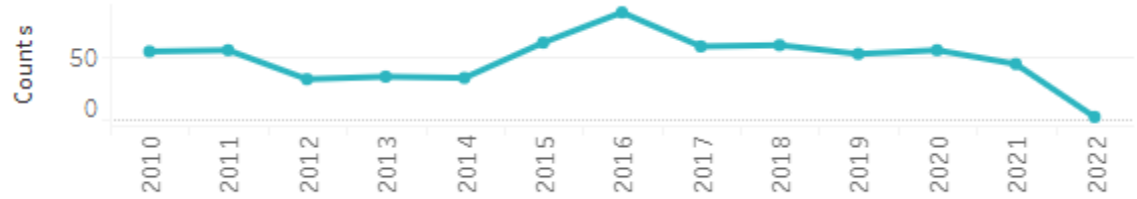
According to the Colorado Department of Transportation Colorado Crash Data Dashboard, between 2010 and March 3, 2022, there have been a total of 37,668 crashes in Thornton, Federal Heights, and Northglenn. Of the crashes 94 were fatal crashes resulting in 221 fatalities and 758 crashes that resulted in 3,886 serious injuries. Overall, September and August had the greatest number of fatal crashes in the planning area. The greatest number of crashes came in 2019 and 2016 with 16 in each year; 2016 also had the greatest number of serious injury crashes (85).

Figure 4-18 Fatal Crashes by Year



Source: CDOT Colorado Crash Data Dashboard

Figure 4-19 Serious Injury Crashes by Year



Source: CDOT Colorado Crash Data Dashboard

As discussed under Section 4.10 Hazardous Materials, 33% of hazardous materials incidents in the planning area in the last 28 years were the result of mobile or transportation incidents. Refer to Section 4.10 for more information on hazardous materials incidents.

4.11.3 Location

Overall, the geographic extent of this hazard is **significant**.

Transportation incidents can occur anywhere along a transportation route. Specific areas of concern include the major highways (I-25 and E-470) in the planning area. While there are no airports within the planning area, there are five airports in the metro area that often use the airspace above the three cities and accidents in the air are possible, as noted under the Previous Occurrences section.

There is one commuter rail line in the planning area owned by the Regional Transportation District (RTD), the N-Line that runs from Union Station in Denver and will eventually end in North Adams County. The Line crosses through Thornton and Northglenn with current stops near E. 88th Avenue and E. 104th Avenue, and Eastlake and 124th Avenue in Thornton and near E. 112th Avenue in Northglenn. There are no rail lines in the City of Federal Heights.

Figure 4-20 The North Metro Rail Line



Source: RTD

4.11.4 Magnitude/Severity

Transportation incidents can almost always be expected to occur in specific areas, on or near airports, roadways, or other transportation infrastructure. The exception is air transportation incidents, which can occur anywhere. However, it is difficult to predict the magnitude of any specific event because these types of events are accidental and the circumstances surrounding these events will impact the extent of damage or injuries that occur. The number of car accidents from 2010 through March 3, 2022, was a total of 37,668 crashes during this 12-year time period (average 3,139 per year). In this time period 221 fatalities occurred, an average of 18 per year.

The N-Line commuter rail trains are electrically powered and have a different hazard profile than diesel-powered trains.

Despite the high number of people killed in traffic accidents, most accidents have few impacts beyond the immediate accident site beyond the closure of roads or rail lines. Overall magnitude/severity is **moderate**.

4.11.5 Probability of Future Occurrences

Safety is the top priority throughout the transportation and infrastructure industries. Over the years safety features and technologies have continued to evolve, adapt, and become more common features throughout the transportation and infrastructure industries. While incident avoidance and impact reduction systems are increasingly becoming more common in modern transportation and infrastructure, the increasing usage of transportation and infrastructure systems that are older and not equipped with the latest safety features and designs increases the chances of incidents occurring. Large-scale transportation and infrastructure incidents have low probabilities, but high impacts. Small-scale transportation and infrastructure incidents have high probabilities, but low impacts. Thornton, Federal Heights, and Northglenn each regularly experience many small-scale transportation and infrastructure incidents, such as automobile crashes and utility malfunctions. However, large-scale incidents are experienced less frequently, but they are possible, and it is important to remain cognizant of them.

Fatal traffic accidents occur several times a year in the planning area. Transportation accidents with major impacts beyond the immediate crash site are less common but still **occasional**

4.11.6 Climate Change Considerations

The future impacts of climate are not expected to influence future hazards events.

4.11.7 Vulnerability Assessment

People

Those who use the surface transportation system are most vulnerable. Travelers, truckers, delivery personnel, and commuters are at risk the entire time they are on the road. This is also true before and after major gatherings such as sporting events, concerts, and conventions. As noted under Previous Occurrences, between 2010 and March 3, 2022, there were 758 crashes that resulted in 3,886 serious injuries and 94 fatal crashes resulting in 221 fatalities. Pedestrians and citizens of the community are less vulnerable but still not immune from the impacts of transportation accidents. According to CDOT's Colorado Crash Data Dashboard, between 2010 and March 3, 2022, there have been 305 crashes involving non-motorists, 166 of which were pedestrians. Non-motorists crossing or entering at intersections were the most commonly identified type of crash.

For railway transportation incidents, people and property in close proximity to the railway lines, crossing, sidings, switching stations, and loading/unloading points are most at risk. Those away from railroad tracks and facilities are vulnerable only to large-scale incidents including those in which hazardous materials are involved.

General Property

No citywide loss estimates were calculated for any of the three cities due to lack of data. Generally, property involved by such an event would likely be insured but impacts would be small, targeted, and would likely not last for a long period of time.

Critical Facilities and Infrastructure

Incidents involving highway accidents can result in injuries, fatalities, closed roads, rerouted traffic, and a strain on the capacity of emergency service personnel who must respond to the incident. Any of these impacts can apply to critical facilities. Highway accidents can affect the flow of traffic and the ability of residents to travel within and out of the jurisdiction.

Economy

The U.S. Department of Transportation Federal Highway Administration issued a technical advisory in 1994 providing suggested estimates of the cost of traffic crashes to be used for planning purposes. These figures were converted from 1994 dollars to 2020 dollars; The costs are listed below in Table 4-37.

Table 4-37 Costs of a Traffic Crash

Severity	Cost per injury (in 2020 dollars)
Fatal	$4,632,233
Evident Injury	$64,139
Possible Injury	$33,851
Property Damage Only	$3,563

Source: U.S. Department of Transportation Federal Highway Administration Technical Advisory T 7570.2, 1994. Adjusted to 2020 dollars.

Historic, Cultural and Natural Resources

Generally, all cultural facilities and the natural environment could be impacted by such an event, but impacts are typically small, targeted, and would likely not last for a long period of time.

Land Use and Development

As population and development continues to increase the number of vehicles on the road will also increase. Transportation incidents in terms of conflicts between motorists and non-motorists are being addressed through the city plans such as Connect Northglenn and the Thornton Transportation and Mobility Master Plan.

4.11.8 Jurisdictional Differences

The City of Federal Heights does not have any rail lines or major highways that cross through the City. U.S. Route 287 borders the city to the west. There have been 1,701 automotive crashes in Federal Heights between 2010 and March 3, 2022.

One major highway, Interstate 25, bisects the City of Northglenn. The N Line, a commuter rail line, and portions of the Union Pacific line also crosses through the city. There have been 1,701 automotive crashes in Federal Heights between 2010 and March 3, 2022.

Interstate 25 runs north-south through portions of Thornton to the south and run parallel to portions of the city in north where it meets E-470. The N Line, a commuter rail line, and portions of the Union Pacific line also crosses through the city. There have been 25,955 automotive crashes in Thornton between 2010 and March 3, 2022.

The risk of mass transportation incidents was not profiled in the 2017 HMP.

4.11.9 Risk Summary

- The overall significance of mass transportation incidents in the planning area is **medium**.
- Major transportation accidents can have impacts on the transportation sector affected, including short or long-term disruption in services.
- There have been 37,653 total crashes in the past 12 years; 624 resulted in 3,807 serious injuries and 94 were fatal crashes resulting in 221 fatalities.
- Related Hazards: Hazardous Materials Incidents, Severe Storms (Cold and Warm Weather), Flood, Tornado and Microburst.

4.12 Public Health Hazards: Communicable Diseases, Epidemics, Pandemics, etc.

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Critical	Occasional	**High**
Northglenn	Extensive	Critical	Occasional	**High**
Thornton	Extensive	Critical	Occasional	**High**

4.12.1 Hazard Description

The scale of a biological incident is described by the extent of the spread of disease in the community. An outbreak can be classified as an endemic, an epidemic, or a pandemic depending on the prevalence of the disease locally and around the world. An **endemic** hazard is something that is natural to or characteristic of a particular place, population, or climate. For example, threadworm infections are endemic in the tropics. An **epidemic** is a disease that spreads rapidly through a demographic segment of the human population, such as everyone in a given geographic area, a similar population unit, or everyone of a certain age or sex, such as the children or women of a region. A **pandemic** is a widespread epidemic that affects whole countries or the entire world.

Many potential devastating diseases are spread through physical contact, ingestion, insects, and inhalation. Airborne diseases and those spread through physical contact pose higher risks to the community because they are difficult to control. Diseases such as influenza, Pertussis, Tuberculosis, and meningitis are all spread through these methods and pose a threat to all communities. Health agencies closely monitor for diseases with the potential to cause an epidemic and seek to develop and promote immunizations.

A pandemic flu is a flu that causes a global outbreak, or pandemic, of serious illness. A flu pandemic occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine. This disease spreads easily person-to-person, causing serious illness, and can sweep across the country and around the world in a very short time. The Centers for Disease Control and Prevention (CDC) has been working closely with other countries and the World Health Organization to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with pandemic planning and preparation.

An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Pandemics are generally thought to be the result of novel strains of viruses. Because of the process utilized to prepare vaccines, it is impossible to have vaccine pre-prepared to combat pandemics. A portion of the human and financial cost of a pandemic is related to lag time to prepare a vaccine to prevent future spread of the novel virus. In some cases, current vaccines may have limited activity against novel strains.

During 2009 and 2010 health professionals around the globe worked to combat the H1N1 influenza virus. This relatively mild and stable influenza virus circulated across the globe and caused one of the most robust worldwide vaccination campaigns since the 1970s. Health professionals continue to monitor the possibility of an avian (bird) flu pandemic associated with a highly pathogenic avian H5N1 virus. Since 2003, avian influenza has been spreading through Asia. A growing number of human H5N1 cases contracted directly from handling infected poultry have been reported in Asia, Europe, and Africa, and more than half the infected people have died. There has been no sustained human-to-human transmission of the disease, but the concern was that H5N1 might evolve into a virus capable of human-to-human transmission.

Since March 2020 and throughout the update of this plan, the three cities, the nation, and the world were dealing with the COVID-19 pandemic, confirming that pandemic is a key public health hazard in the county. Unlike seasonal flu, an influenza pandemic has much greater potential for loss of life and significant social disruption due to higher rates of transmission and more severe health impacts. The COVID-19 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission of droplets/bodily fluid. Common symptoms include fever, cough, fatigue, shortness of breath or breathing difficulties, and loss of smell and taste. While most people have mild symptoms, some people develop acute respiratory distress syndrome with roughly one in five requiring hospitalization and a fatality rate of approximately 1%. A key challenge in containing the spread has been the fact that it can be transmitted by people who are asymptomatic. Even with a strong healthcare system, disease outbreaks can strain and overwhelm community resources if there is a significant outbreak. The cities' vulnerable populations, young children, the elderly, the poor and those with underlying health conditions, will be the hardest hit during any disease outbreak.

4.12.2 Previous Occurrences

Public health hazards can manifest as primary events by themselves, or they may be secondary to another disaster or emergency, such as a flood, a severe storm, or a hazardous materials incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people.

Since the early 1900s, five lethal pandemics have swept the globe:

1918-1919 Spanish Flu: The Spanish Flu was the most severe pandemic in recent history. The number of deaths was estimated to be 50-100 million worldwide and 675,000 in the United States. Its primary victims were mostly young, healthy adults. At one point, more than 10 percent of the American workforce was bedridden.

1957-1958 Asian Flu: The 1957 Asian Flu pandemic killed 1.1 million people worldwide, including about 70,000 people in the United States, mostly the elderly and chronically ill. Fortunately, the virus was quickly identified, and vaccine production began in May 1957.

1968-1969 H3N2 Hong Kong Flu: The 1968 Hong Kong Flu pandemic killed one million people worldwide and approximately 100,000 people in the United States. Again, the elderly were more severely affected. This pandemic peaked during school holidays in December, limiting student-related infections, which may have kept the number of infections down. Also, people infected by the Asian Flu ten years earlier may have gained some resistance to the new virus.

2009-2010 H1N1 Swine Flu: This influenza pandemic emerged from Mexico in early 2009 and was declared a public health emergency in the U.S. on April 26. By June, approximately 18,000 cases had been reported in the U.S. and the virus had spread to 74 countries. Most cases were fairly mild, with symptoms similar to the seasonal flu, but there were cases of severe disease requiring hospitalization and a number of deaths. The CDC estimates that 43-89 million people were infected worldwide, with an estimated 8,870 to 18,300 H1N1 related deaths, including 12,469 deaths in the United States. The potential threat of this virus created a need for Denver Public Health (DPH) to plan for the distribution of H1N1 shots. DPH launched a media blitz to deliver awareness and prevention messages. DPH had the responsibility for ensuring that limited amounts of early vaccine were directed to priority groups. The process of tracking and distributing this limited supply allowed DPH to establish important partnerships with more than 200 different health care providers throughout Denver. Partnering with Denver Environmental Health, DPH held public H1N1 vaccination clinics in late fall, immunizing thousands of children and adults against H1N1. Throughout the 2009 flu season, DPH dispensed 16,602 doses of H1N1 vaccine.

2020-Ongoing COVID-19: The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March of 2020. As of June 1, 2022, 505 million cases have been reported around the world with 6.2 million deaths. The United States has seen more than 84 million cases and 1 million deaths; of those, 1.4 million cases and 13,000 deaths have been in Colorado. In Adams County there have been 142,000 cases and 1,390 deaths as of June 1, 2022.

Table 4-38 COVID-19 Statistics as of July 1, 2022

Geographic Area	Cases	Hospitalizations	Deaths
Worldwide	547,000,000	*(unavailable)*	6,340,000
United States	87,407,521	4,947,000	1,013,261
Colorado	1,538,051	64,721	13,187
Federal Heights	4,038	227	25
Northglenn	10,749	501	109
Thornton	38,056	1,621	290

Source: US Centers of Disease Control & Prevention

The Colorado Department of Public Health and Environment releases an annual reportable disease summary for each county. The events with the highest incidences in Adams and Weld County between 2009 and 2018 (the most recent year for which data has been released as of 2022) are summarized in the tables below.

Table 4-39 Colorado Reportable Disease Statistics (CDPHE), Adams County

Disease	Number of Cases Per Year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Acute Flccid Myelitis						1				1	1
Animal Bites	14	11	53	77	66	866	59	210	167	193	866
Botulism, Infant						1			1		1
Brucellosis	-	-	-	-	-	2				1	2
CJD						1			1		1
Campylobacter	55	54	50	40	42	581	59	77	67	80	581
Candidemia						39			13	26	39
Carbapenem-Resistant Enterobacteriaceae (CRE)						61			31	30	61
Carbapenem-Resistant Pseudomonas Aeruginosa (CRPA)						222			128	94	222
Colorado Tick Fever						0					0
Cryptosporidiosis	7	4	4	5	8	66	4	13	7	7	66
Crclosporiasis						2				2	2
Encephalitis Other	2	-	-	-	2	14	3	1	1	2	14
Giardiasis	33	68	24	22	29	329	20	41	27	42	329
Group A Strep Invasive	23	30	29	22	19	366	45	47	48	69	366
Group B Strep Invasive	48	25	35	38	32	786	427	56	38	43	786
Haemophilus Influenzae	4	9	5	8	14	85		12	6	17	85
Hantavirus Pulmonary Syndrm	-	-	-	1	-	3		1		-	3
Hemolytic Uremic Syndrome	2	1	-	1	-	11	2		2	2	11
Hepatitis A	2	4	1	4	1	27	1	2	9	3	27
Hepatitis B, Acute	7	5	1	4	3	31			3	-	31

Disease	Number of Cases Per Year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Hepatitis B, Chronic	74	63	46	50	58	580	58	62	46	57	580
Hepatitis B, Perinatal Infection	-	-	-	-	1	2	1			-	2
Hepatitis C, Acute	4	-	1	2	1	22	1	2	3	7	22
Hepatitis C, Chronic	216	199	216	196	161	2350	191	299	342	325	2350
Hepatitis D						1		1			1
Influenza-Hospitalized	343	22	97	86	174	2177	154	184	400	418	2177
Influenza-Pediatric Death	1	-	-	-	-	2				-	2
Kawasaki Syndrome	5	7	7	7	10	38				-	38
Legionellosis	5	5	4	2	6	44	4	10	5	-	44
Leprosy (Hansen Dis)	-	1	-	-	-	1				-	1
Listeriosis	1	1	3	1	1	17	1		3	4	17
Lyme Disease						1				1	1
Malaria	1	2	-	5	3	27	4	3	2	2	27
Meningitis Aseptic/Viral	15	32	19	13	30	129				-	129
Meningococcal Disease	2	-	2	1	-	8		1		-	8
Mumps	-	2	1	-	1	15		1	1	8	15
Pertussis	13	56	54	206	138	920	102	60	77	54	920
Plague	-	-	-	-	-	4					4
Rocky Mnt Spotted Fever						1	1				1
Salmonellosis	58	43	46	50	46	512	49	65	62	44	512
Shigellosis	10	11	8	13	32	133	10	11	15	16	133
STEC (Shiga Toxin Producing E.coli)	9	28	14	20	11	186	19	14	22	31	186
Strep Pneumo Invasive	81	56	48	40	57	515	39	45	54	52	515
Toxic Shock-Other	1	1	-	-	-	5	2		1		5
Toxic Shock-Strep	-	1	-	-	-	1					1
Tularemia	-	-	-	-	-	6	3	2			6
Typhoid Fever	-	-	-	3	-	7	1	1			7
Varicella (Chicken Pox)	51	47	42	37	27	333	15	22	33	31	333
Vibriosis						2			1	1	2
West Nile Virus	-	3	-	-	-	10			4	3	10
Yersiniosis	2	-	3	-	5	16	1		1	3	16
Zika						3			3		3
Total:	**1089**	**791**	**813**	**954**	**978**	**1125**	**1276**	**1243**	**1624**	**1669**	**11562**

Source: Division of Disease Control and Environmental Epidemiology, CDPHE

Table 4-40 Colorado Reportable Disease Statistics (CDPHE), Weld County

Disease	Number of Cases Per Year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Animal Bites	39	49	36	40	86	38	33	92	98	179	690
Campylobacter	68	81	86	51	80	56	83	108	117	103	833
Carbapenem-Resistant Enterobacteriaceae (CRE)									16	20	36
Carbapenem-Resistant Pseudomonas Aeruginosa (CRPA)									89	76	165
CJD									1		1

Disease	Number of Cases Per Year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Cryptosporidiosis	12	26	12	4	9	5	9	10	17	26	130
Cyclosporiasis										3	3
Dengue Fever								1			1
Encephalitis Other	1	2	-	-	2	2		1		2	10
Giardiasis	22	26	13	6	10	11		11	15	20	134
Group B Strep Invasive									1	1	2
Haemophilus Influenzae	5	5	4	2	6	2	4	6	7	3	44
Hemolytic Pulmonary Syndrome	-	2	2	-	-						4
Hantavirus Pulmonary Syndrome							1				1
Hemolytic Uremic Syndrm	-	-	2	-	2	1		1	5	4	15
Hepatitis A	7	-	1	1	1	2	2	3	1		18
Hepatitis B, Acute	-	1	1				2		1	3	8
Hepatitis B, Chronic	20	27	26	23	18	7	24	29	16	18	208
Hepatitis C, Acute	-	2	-	2	3	-	1	1		1	10
Hepatitis C, Chronic	106	107	111	87	89	100	116	163	214	192	1285
Hepatitis C, Perinatal Infection										1	1
Influenza-Hospitalized	155	5	77	57	145	200	80	90	204	200	1213
Influenza-Pediatric Death									1		1
Kawasaki Syndrome	1	6	2	5	5	-					19
Legionellosis	1	1	1	1	-	1	3	3	4	2	17
Listeriosis	-	-	2	-	2	1				1	6
Lyme Disease									1		1
Malaria	-	-	-	-	2	1		1		1	5
Meningitis Aseptic/Viral	41	18	10	42	38	13					162
Meningococcal Disease	-	3	-	-	-	-				3	6
Mumps	-	-		1	-	1			4		6
Pertussis	4	10	5	83	94	183	57	34	14	24	508
Q Fever Acute									2		2
Relapsing Fever	-	-	-	-	1						1
Rocky Mtn Spotted Fever	-	1	-	1							2
Salmonellosis	44	28	25	43	45	33	40	42	48	84	432
Shigellosis	7	10	8	41	6	3	4	9	9	7	104
STEC (Shiga Toxin Producing E.Coli)	9	10	10	6	14	8	17	15	23	28	140
Spotted Fever Group Rickettsia									2		2
Strep Pneumo Invasive	35	29	32	17	22	24	28	31	34	29	281
Tetanus	-	-	-	1	-	-					1
Toxic Sock-Other							1	2			3
Toxic Shock-Strep								1			1
Tularemia	1	1	1	-		1	7		1		12
Typhoid Fever							3				3
Varicella (Chicken Pox)	37	14	12	11	14	12	17	20	19	12	168
Vibriosis										2	2
West Nile Virus	-	18	-	-	-	-			14	15	47
Total:	**615**	**482**	**479**	**525**	**694**	**705**	**532**	**674**	**978**	**1060**	**6744**

Chronic Hepatitis C and hospitalizations from influenza represent the largest disease incidence in both Adams and Weld Counties between 2009 and 2018.

4.12.3 Location

The geographic extent of this hazard is **extensive**; the entire planning area is susceptible to the spread of infectious disease. Disease spread usually occurs in areas where vulnerable populations are, and also in areas where people live and work in close quarters. Depending on the specifics of the illness and its spread, these areas include shelters, senior homes, schools, places of business.

The current COVID-19 pandemic has affected all 64 Colorado counties. All neighborhoods in the cities are likely to be impacted, either directly or indirectly. Some indirect consequences may be the diversion of resources that may be otherwise available.

4.12.4 Magnitude/Severity

The magnitude of a public health emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission, but a major pandemic can have **critical** impacts.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster. Pandemics typically last for several months to 1-2 years.

As seen with the ongoing COVID-19 pandemic in the three cities and the State of Colorado, the rapid spread of the virus combined with the need for increased hospital and coroner resources, testing centers, first responders, and vaccination administration sites caused significant strain on the medical system and public health departments. Additionally, other public health related triggers or comingled public health hazards (such as an outbreak of another pathogen) or even a more contagious strain of SARS-CoV-2 such as the recent Omicron and Delta B.1.617.2 variant can quickly lead to even more outbreaks and tip the cities into the high-risk category.

The Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of an influenza pandemic. This framework is used to guide influenza pandemic planning and provides recommendations for risk assessment, decision-making, and action. These intervals provide a common method to describe pandemic activity, which can inform public health actions. It can also be used to portray typical impacts during each phase. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

The six-phase approach was designed for the easy incorporation of recommendations into existing national and local preparedness and response plans. Phases 1 through 3 correlates with preparedness in the pre-pandemic interval, including capacity development and response planning activities, while Phases 4 through 6 signal the need for response and mitigation efforts during the pandemic interval.

Pre-Pandemic Interval

In nature, influenza viruses circulate continuously among animals (primarily birds). Even though such viruses might develop into pandemic viruses, in Phase 1 no viruses circulating among animals have been reported to cause infections in humans.

Phase 1 is the natural state in which influenza viruses circulate continuously among animals but do not affect humans.

In **Phase 2** an animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is thus considered a potential pandemic threat. Phase 2 involves cases of animal influenza that have circulated among domesticated or wild animals and have caused specific cases of infection among humans.

In **Phase 3** an animal or human-animal influenza virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for examples, when there is close contact between an infected person and an unprotected caregiver. Limited transmission under these circumstances does not indicate that the virus has gained the level of transmissibility among humans necessary to cause a pandemic. Phase 3 represents the mutation of the animal influenza virus in humans so that it can be transmitted to other humans under certain circumstances (usually very close contact between individuals). At this point, small clusters of infection have occurred.

Pandemic Interval

Phase 4 is characterized by verified human to human transmission of the virus able to cause "community-level outbreaks." The ability to cause sustained disease outbreaks in a community marks a significant upward shift in the risk for a pandemic. Phase 4 involves community-wide outbreaks as the virus continues to mutate and become more easily transmitted between people (for example, transmission through the air)

Phase 5 is characterized by verified human to human spread of the virus into at least two countries in one World Health Organization (WHO) region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short. Phase 5 represents human-to-human transmission of the virus in at least two countries.

Phase 6, the pandemic phase, is characterized by community-level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is underway. Phase 6 is the pandemic phase, characterized by community-level influenza outbreaks.

4.12.5 Probability of Future Occurrences

Although it is impossible to predict the next disease outbreak, there is recent history that shows these outbreaks are common 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, a probability rating of **occasional**.

As mentioned above, nowadays, cities have become ideal breeding grounds for epidemics. Meanwhile, the explosive growth in air travel makes virus capable of transmitting globally simply within hours. Under such conditions, there may be very little warning time. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. For the current COVID-19 pandemic, due to the virus' ability to mutate and rapidly infect those who have not been vaccinated, the pandemic may extend for several years, and booster vaccines may be necessary to prevent future outbreaks.

4.12.6 Climate Change Considerations

According to the best available data, the changing climate is expected to exacerbate future pandemics. Climate change will influence vector-borne disease prevalence, although the direction of the effects (increased or decreased incidence) will be location- and disease specific. The intensity and extent of certain diseases is projected to increase. Climate change threatens to increase the spread of infectious diseases because changing heat, rain, and humidity levels allow disease carrying vectors and pathogens to come into closer contact with humans. If Colorado's climate becomes warmer, mosquito populations could swell, making the region more favorable for disease transmission. Warmer weather could also play a role in elevated seasonal deer mouse populations, which is significant because deer mice carry and spread Lyme disease and are the primary carriers of hantavirus in the US. Disadvantaged populations such as people with compromised health and those in lower socioeconomic status communities are expected to bear a greater burden because of their current reduced access to medical care and limited resources for adaptation strategies.

Additional research is needed to determine the effects of climate change on the frequency and duration of epidemics and pandemics.

4.12.7 Vulnerability Assessment

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. According to 2020 Census data (see Section 3.3), 7.5% of the population of the three cities are under age 5, 9.8% are over 65, and 10% do not have health insurance. Impacts, mortality rates, speed and type of spread are disease-specific, though certain illnesses could cause high infectivity and mortality rates. As seen with the current COVID-19 pandemic statewide, although the most positive cases occurred in the 20-29 age group, hospitalizations and deaths disproportionately affected the elderly.

General Property

Communicable disease would not have specific impacts to the built environment. Businesses could be impaired by absenteeism, sick days and isolation, quarantine, and disease prophylaxis measures. As concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Additionally, traditional sheltering facilities including homeless shelters or facilities stood up to support displaced persons due to an evacuation or other reason due to a simultaneous disaster occurring cannot be done in a congregate setting. This requires additional planning considerations or use of facilities that allow for non-congregate shelter settings which may require an 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 and Infrastructure

Critical infrastructure impacts from a communicable disease would primarily center on service interruption due to people missing work and being unable to provide service. Automated systems would fare better due to this lost productivity, but even they would be vulnerable if the disease impacts were protracted. Critical services could also be impaired by isolation, quarantine, and disease prophylaxis. The development

of Continuity of Operations Plans (COOP) is essential to ensure critical facilities can continue to operate during a pandemic.

Economy

Widespread communicable disease outbreaks can have devastating impacts on the economy. Economic impacts fall under two categories – economic losses as a result of the disease, and economic losses to fight the disease. Economic impacts as a result of disease include those costs associated with lost work and business interruption. Depending on the disease and the type and rate of spread, businesses could see loss of consumer base as people self-isolate or avoid travel to the cities. This could last for a protracted amount of time, compounding economic loss. Economic costs are also associated with incident response. Two of the biggest areas of cost are in public information efforts and mass prophylaxis.

In a normal year, lost productivity due to illness costs U.S. employers an estimated $530 billion. During a pandemic, that figure would likely be considerably high and could trigger a recession or even a depression. According to an October 2020 report by the JAMA Network, the estimated cumulative financial costs of COVID-19 pandemic related to the COVID-19 economic recession and compromised health (premature death, mental health, long-term health impairment) in the U.S. population in the first year of the pandemic was almost $16 trillion.

Historic, Cultural and Natural Resources

Zoonotic diseases are those that can spread from animals to humans, wreaking havoc on both populations. Examples of zoonotic diseases include avian flu, swine flu, tuberculosis, plague, and rabies. Reduced tourism could lead to additional economic impacts.

Land Use and Development

Population growth and development contribute to pandemic exposure. Future development in and around the three cities 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.

4.12.8 Jurisdictional Differences

Given the fact that cities are ideal breeding grounds for epidemics and virus can grow exponentially in air travel, the impact of public health hazards including pandemic and endemics on these three cities would be very similar.

In the 2017 HMP, public health hazards were rated as high significance for the City of Federal Heights, medium significance for the City of Thornton, and low significance for the City of Northglenn. For the 2023 update, a closer analysis of the actual impacts of recent public health events led all three jurisdictions to rank it as high significance.

4.12.9 Risk Summary

- The overall significance in the planning area is **high**.
- Pandemics affecting the U.S. occur roughly once every 20 years but cannot be reliably predicted.
- Effects on people will vary, but a significant portion of the population could become ill, and may need to be hospitalized
- Effects on property are typically minimal, although quarantines could result in short-term closures.

- Community lifelines, such as healthcare facilities, like hospitals will be impacted and may be overwhelmed and have difficulty maintaining operations due to bed availability, medical staffing shortages, and lack of PPE and other supplies.
- Lost productivity due to illness and potential business closures could potentially have severe economic impacts, such as increased unemployment rates in the cities. Social distancing requirements and fear of public gatherings could also significantly reduce in-person commerce.
- The hazard is considered high significance across all three cities.
- Ongoing mitigation activities should focus on disease prevention, especially during flu season. This includes, but is not limited to, pre-season community outreach campaigns to educate the public about risks and available support; establishing convenient vaccination centers; reaching out to vulnerable populations and care givers; and issuing advisories and warnings.

4.13 Severe Cold Weather Storms

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Critical	Highly Likely	**High**
Northglenn	Extensive	Critical	Highly Likely	**High**
Thornton	Extensive	Critical	Highly Likely	**High**

4.13.1 Description

Severe winter weather can cause hazardous driving conditions, communications and electrical power failure, community isolation, and can adversely affect business continuity. This type of snow-related weather may include one or more of the following winter factors: blizzards, heavy snow, ice storms, and extreme cold.

Blizzards, as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for three hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.

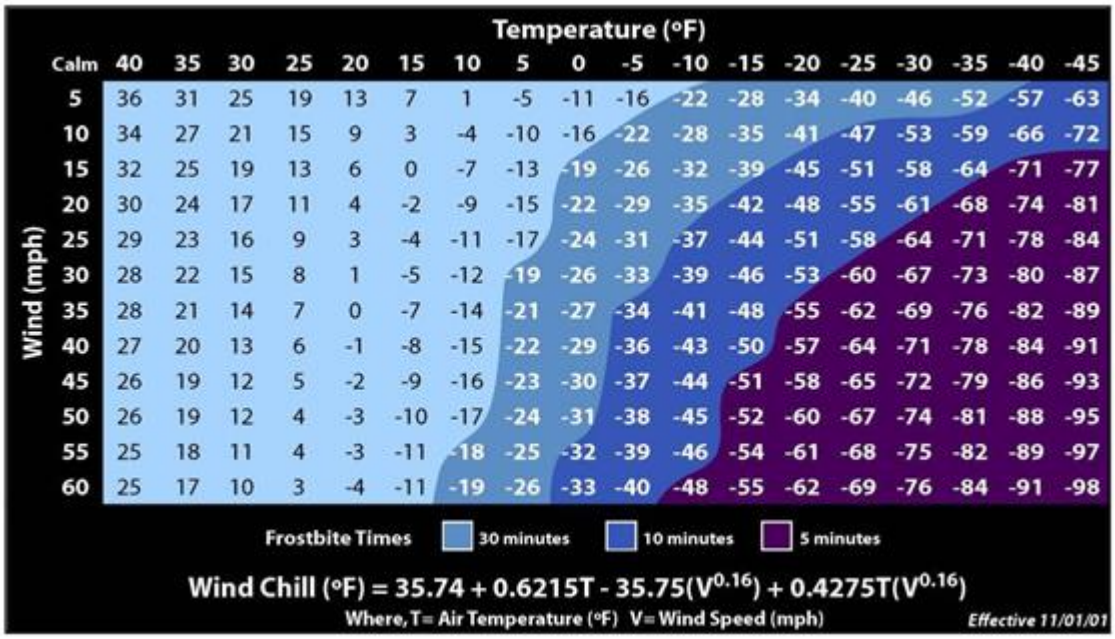
Heavy snow, in large quantities, may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow before the leaves fall from the trees in the fall or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages.

Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth's surface. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines.

Extreme cold, in extended periods, although infrequent, could occur throughout the winter months across the planning area. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop. Wind chill is how cold it "feels" and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. This makes the environment feel much colder than the actual temperature.

As depicted in the following figure, the National Weather Service's Wind Chill Chart shows the difference between actual air temperature and perceived temperature, as well as the amount of time until frostbite occurs.

Figure 4-21 NOAA Wind Chill Chart



Source: NOAA

4.13.2 Previous Occurrences

Past occurrences of severe cold weather storm events in the planning area have been reconstructed using the best available data from the NCEI Storm Events Database, which compiles records at a county zone level. Only those events that occurred in county areas in close proximity to the planning area have been included here.

Since 1996 there have been nine blizzard events, two cold/wind chill events, one extreme cold/wind chill events, one frost/freeze, 40 heavy snow events, 55 winter storm events, and 38 winter weather events, which average to about 5.7 severe cold weather-related events per year.

Table 4-41 shows the history of "significant" winter storms, winter weather, heavy snow, ice storms, cold/wind chill, extreme cold/wind chill, frost/freeze, and blizzards in the cities of Thornton, Federal Heights, and Northglenn since 1996. "Significant" winter storm, winter weather, and blizzard events are included in the NCEI Storm Events Database if the event has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet, and ice) and meets or exceeds locally/regionally defined twelve or twenty-four hour warning criteria for at least one of the precipitation elements on a widespread or localized basis.

Table 4-41 provides a list of historical events that had reportable human injuries and deaths and the value of damages to property or crops. Events that do not have reported injuries, deaths, or damages are not included in the table.

According to the NCEI Storm Events Database there have been 17 reported injuries, four reported deaths, $18,702,000 worth of property damage, and $10,000,000 in reported crop damage associated with the above winter storm events between 1996 and 2021. However, estimates for injuries, deaths, property damage, and crop damage reflect impacts across the entire affected area, which frequently covers multiple counties.

Table 4-41 Historic Severe Cold Weather Events in the Cities of Thornton, Federal Heights, and Northglenn

Date	Event Type	Location	Injuries	Deaths	Damage to Property	Damage to Crops
12/18/1996	Cold/Wind Chill	N Douglas County Below 6000 Feet / Denver / W Adams & Arapahoe Counties / E Broomfield County (Zone)	1	0	0	0
12/18/1998	Cold/Wind Chill	Denver Metropolitan Area (Zone)	3	15	0	0
4/11/2001	Blizzard	Denver Metropolitan Area (Zone)	0	0	$3,100,000	0
3/17/2003	Blizzard	N Douglas County Below 6000 Feet / Denver / W Adams & Arapahoe Counties / E Broomfield County (Zone)	0	2	$15,500,000	0
11/10/2014	Frost/ Freeze	N Douglas County Below 6000 Feet / Denver / W Adams & Arapahoe Counties / E Broomfield County (Zone)	0	0	0	$10,000,000
Total:			**4**	**17**	**$18,600,000**	**$10,000,000**

Source: NOAA; NCEI Storm Events Database

The following event narratives were recorded in the Storm Events Database:

- **December 18, 1998** – An Arctic airmass settled in over northeastern Colorado dropping overnight temperatures well below zero for six consecutive days. Overnight temperatures bottomed out at 19 degrees below zero on the morning of the 22nd. At least 15 people, mostly homeless, were treated for hypothermia at area hospitals. The bitter cold weather was responsible, either directly or indirectly, for at least 5 fatalities. Three of the victims died directly from exposure. The cold weather also caused intermittent power outages. Following the cold snap, thawing water pipes cracked and burst in several homes and business causing extensive damage. No estimate of the damage, however, was available.
- **December 28, 2006** – A slow moving storm system moved from the Desert Southwest and into the Texas Panhandle. As it did, a deep easterly upslope flow occurred along the Front Range, with blizzard conditions developing over portions of the Northeast Plains of Colorado, mainly south of Interstate 76. The heaviest snow fell along east facing slopes with storm totals up to 2 1/2 feet in the North Central Mountains and Front Range Foothills. Across the Interstate 25 Corridor storm totals ranged from 6 to 18 inches, heaviest near the Front Range Foothills and Palmer Divide. Strong winds and snow brought blizzard conditions to plains of eastern Colorado, forcing the closure of Interstate 70 as well as several other roads and highways. Greyhound Bus Company was forced to cancel all trips out of Denver. Whiteout conditions were reported across eastern portions of Adams, Arapahoe, and Elbert Counties, as well as Lincoln, Phillips, and Washington Counties. Northerly winds 20 to 30 mph were common with gusts to 40 mph. Snow drifts reportedly ranged from 4 to 14 feet in depth.
- **March 13, 2019** – A rapidly intensifying storm system or bomb cyclone brought hurricane strength winds to the northeast plains of Colorado, along with moderate to heavy snowfall. Peak wind gusts ranged from 60 to 80 mph. Thundersnow produced snowfall rates up to three inches per hour just west of Denver. Two records were established at Denver International Airport. A record non-thunderstorm wind gust of 80 mph broke the previous record of 63 mph set in Match 13, 2009. A record low sea level pressure of 979.01 MB broke the previous record of 979.9 MB set on February 25, 1998. Snowfall amounts ranged from 2 to 6 inches near the base of the foothills, with up to 20 inches in the mountains and foothills. Along the Palmer Divide east of I-25 and the northeast plains of Colorado, storm totals ranged from 4 to 10 inches.
    - Widespread outages, multi-vehicle accidents and road closures prompted the governor to declare a state of emergency which activated the Colorado National Guard to assist state and

local authorities in rescuing hundreds of stranded motorists. Disaster declarations included the following counties and cities: Adams, Arapahoe, Douglas, Elbert counties, as well as the city of Aurora. Multiple accidents included a 100-car pileup on Interstate 25, from MM 285 to the WY border; with another 100-car accident south of Denver toward Monument. A state trooper was struck and killed on Interstate 76.

- Nearly 1400 flights in and out of Denver International Airport were canceled due to the blizzard. Five thousand passengers were stranded at the airport. The number of people who lost power during the storm totaled 445,000. Xcel Energy called in over 500 employees to work to restore power with additional 300 out-of-state workers on their way to assist. Approximately 85,000 people, mostly in the Denver area, were without electricity the following day. At least 335 vehicles were stuck and abandoned on Interstate 25 near Larkspur. In Denver, 250 vehicles were abandoned during the storm. School buses were used to rescue stranded drivers. At least 33 public school districts were closed on the 13th and 14th. Warming centers and shelters opened area wide.

4.13.3 Location

Severe cold weather storms are often regional events, and any given event will typically affect significant portions of the planning area. The entire planning area is susceptible to the snow, winds, and cold temperatures associated with severe cold weather storms. The geographic extent is therefore **extensive**.

4.13.4 Magnitude/Severity

The potential magnitude of winter storms can be **critical**. Winter storms affect the entire planning area including all above-ground structures and infrastructure. Although losses to structures are typically minimal, there can be secondary impacts associated with lost time, maintenance costs, and damaged building contents. A timely forecast may not be able to mitigate property loss but can reduce storm-related casualties and injuries. The National Weather Service in Boulder issues Winter Storm Warnings when life-threatening conditions are imminent or already occurring.

The HMPC noted that the severity of impacts of severe cold weather storms can vary depending on the time of year they occur. Spring storms are common and can produce significant damage and debris. A Mother's Day Storm in 2005 resulted in significant amounts of broken tree branches and other debris to clean up. Even relatively minor winter storms can have a huge impact on city resources, requiring the activation of shelters, severe weather plans, and others.

The elderly, young children, the homeless, outdoor laborers, the infirm, and members of low-income communities are the most likely to suffer the negative effects of extreme cold. The National Weather Service issues wind chill warnings to provide advanced notification for preparedness and response purposes. The table below describes the criteria for these warnings.

Table 4-42 National Weather Service Wind Chill Warnings

Warning	Description
Wind Chill Watch	Issued by the NWS when there is a chance that wind chill temperatures will decrease to at least 24°F below zero during the next 24 to 48 hours.
Wind Chill Advisory	Issued when the wind chill could be life threatening if action is not taken. The criteria for this advisory are expected wind chill readings from 15°F to 24°F below zero.
Wind Chill Warning	Issued when wind chill readings are life threatening. Windchill readings of 25°F below zero or lower are expected.

Source: NWS

4.13.5 Probability of Future Occurrences

Severe winter storms can be predicted with a reasonable level of certainty. Through the identification of various indicators of weather systems, and by tracking these indicators, warning time for snowstorms can be as much as a week in advance. However, subtle shifts in the track of the low-pressure center can radically change storm totals from predictions as little as 12-hours earlier from "little to no snow" to 18 inches. Understanding the historical frequency, duration, and spatial extent of severe winter weather assists in determining the likelihood and potential severity of future occurrences. The characteristics of past severe winter events provide benchmarks for projecting similar conditions into the future. The probability that Thornton, Federal Heights, and Northglenn will experience a severe winter storm event can be difficult to quantify. However, based on historical records and frequencies of 148 severe cold weather storm related events over the last 25 years, which averages to about 5.7 severe cold weather-related events per year, there is nearly a 100% chance of this type of event will occur somewhere within the planning area at least once every year. The probability is **highly likely**.

4.13.6 Climate Change Considerations

As a result of global climate change, the United States is already experiencing more intense rain and snowstorms. The 2018-2023 Colorado State Hazard Mitigation Plan reports that winter storm events are projected to become more severe, with an increase in frequency of winter precipitation events. However, per the Fourth National Climate Assessment, hotter temperatures are reducing the proportion of precipitation fall as snow in the Southwest, and some climate models project less snow and more rain as well as shorter snowfall seasons.

As the planning area prepares for regional changes in climate, it will be important to consider scenarios involving different types of winter precipitation, such as freezing rain, sleet, and ice storms. The impacts have the potential to affect infrastructure, public safety, and the local economy in a diversity of (potentially) negative ways including higher levels of precipitation per storm event as well as soil instability due to drought.

4.13.7 Vulnerability Assessment

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 data from the U.S. Department of Health and Human Services' emPOWER Map site, in Adams and Weld Counties, 12.1% and 9.2% of Medicare Beneficiaries (7,949 of 65,530 total beneficiaries and 4,886 of 53,214 total beneficiaries) rely on electricity-dependent medical and assistive equipment, such as ventilators, to live independently in their homes. Additionally, during extended winter-time power outages, people often make the mistake of bringing portable generators inside or not venting them properly, leading to carbon monoxide poisoning.

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.

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. All four deaths and 15 of the 17 injuries associated with past severe cold weather storm events resulted from were severe cold and hypothermia, and most of the victims were individuals experiencing homelessness. At the time of the Adams County 2021 Point in Time homelessness assessment, there were an estimated 346 people experiencing

homelessness in Adams County, including 139 individuals who were unsheltered and therefore may face greater exposure to extreme cold.

General Property

All assets located within the planning area can be considered at risk from winter storms. Damages to inventory assets exposed to extreme cold is dependent on the age of the building, type, construction material used, and condition of the structure. Heavy snow loads on roofs, particularly large span roofs and/or flat rooftops (often found in public buildings such as schools), can cause roofs to leak or even collapse depending on their construction. Vulnerability is influenced both by architecture and type of construction material and should be assessed on a building-by-building basis. Extreme cold temperatures may cause pipes to freeze and subsequently burst, causing water damage.

Critical Facilities and Infrastructure

Most likely the greatest issue for critical facilities during significant severe cold weather storms is the inaccessibility of such facilities due to poor roadways, utility outages, or dangerous wind chills. During periods of heavy snow, ice, or blizzards, roads can quickly become impassable, stranding motorists and isolating communities. Long term road closures during an extended cold period may diminish and threaten propane and fuel supplies. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption
- Water and fuel shortages
- Road closures
- Damaged infrastructure components, such as sewer lift stations and treatment plants
- Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Additionally, during the winter months, freezing temperatures and repeated freeze-thaw events can cause potholes, which may damage vehicles. Hazardous travel conditions may result if potholes are not tended to promptly. Frozen pipes, a common occurrence during extreme cold events, can cause service interruptions in water supply, gas supply, and drainage.

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 may result in economic disruptions. Severe cold weather events also often require shelter activation and response activities, which have a significant impact on local resources.

Historic, Cultural and Natural Resources

Natural resources may be damaged by the severe winter weather, including broken trees and death of wildlife. Unseasonable storms may damage or kill plants and wildlife, which may impact natural food chains until the next growing seasons. Most of these impacts are short-term.

As noted previously, older, historic buildings could potentially be more vulnerable to roof and structural damage from heavy snow.

Land Use and Development

All future structures built in in the planning area will be exposed to severe cold weather storms. As development pressures increase and new construction speeds up in the area over time Thornton, Northglenn, and Federal Heights must continue to adhere the best available building code standards to account for the impacts of adverse weather.

4.13.8 Jurisdictional Differences

Severe cold weather storms are expected to occur uniformly and present similar risks across the planning area; however, variations in local vulnerability mean that some jurisdictions may have greater risk. The table below shows demographic data by jurisdiction related to populations vulnerable to extreme cold. Based on Census information and knowledge of social vulnerability to hazards, jurisdictions with high numbers of elderly residents, a high poverty rate and/or large numbers of rental properties can plan accordingly to provide appropriate services and mitigation assistance during extreme cold weather storm events.

Table 4-43 Populations Vulnerable to Extreme Temperatures

Jurisdiction	Age: 65 and Over (%)	Persons Below Poverty Level (%)	Renter-occupied housing units (%)
Colorado	13.8	10.3	34.8
City of Thornton	9.3	8.8	27.2
City of Federal Heights	10.3	20.7	47.5
City of Northglenn	11.6	11.3	46.2

Source: American Community Survey 5-Year Estimates, 2015-2019

Compared to the State, the City of Federal Heights has a slightly lower percentage of people over the age of 65, but a much higher proportion of people below the poverty level and a high proportion of renters. Based on these statistics, Federal Heights may have higher social vulnerability to severe cold weather storms.

Compared to the State, the City of Northglenn has a slightly lower percentage of people over the age of 65, but a higher proportion of people below the poverty level and a much higher proportion of renters. Based on these statistics, Northglenn may have higher social vulnerability to severe cold weather storms.

Compared to the State average, the City of Thornton has a slightly lower percentage of elderly residents, people below the poverty level, and renter-occupied housing. Therefore, social vulnerability to severe cold weather storms may be slightly lower in Thornton than the rest of the planning area.

All three Cities ranked severe cold weather as high significance in the 2017 HMP, and agreed that ranking is still valid for the 2023 update.

4.13.9 Risk Summary

- The overall significance in the planning area is **high**.
- The planning area averages 5.7 severe winter storm related events annually.
- Extreme cold has caused the majority of deaths and injuries related to severe cold weather storms.
- Power outages can result from heavy snow, ice, and winds.
- Heavy snow loads can damage buildings and vegetation.

4.14 Severe Warm-Weather Storms: Wind, Hail, Lightning

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Extensive	Moderate	Highly Likely	**Medium**
Northglenn	Extensive	Moderate	Highly Likely	**Medium**
Thornton	Extensive	Moderate	Highly Likely	**Medium**

4.14.1 Description

Severe warm-weather storms in these three cities are 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. 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 three cities in different ways – high winds, hail, and lightning. (Tornadoes and microbursts are addressed in Section 4.16.)

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 refreezing it. 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 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.

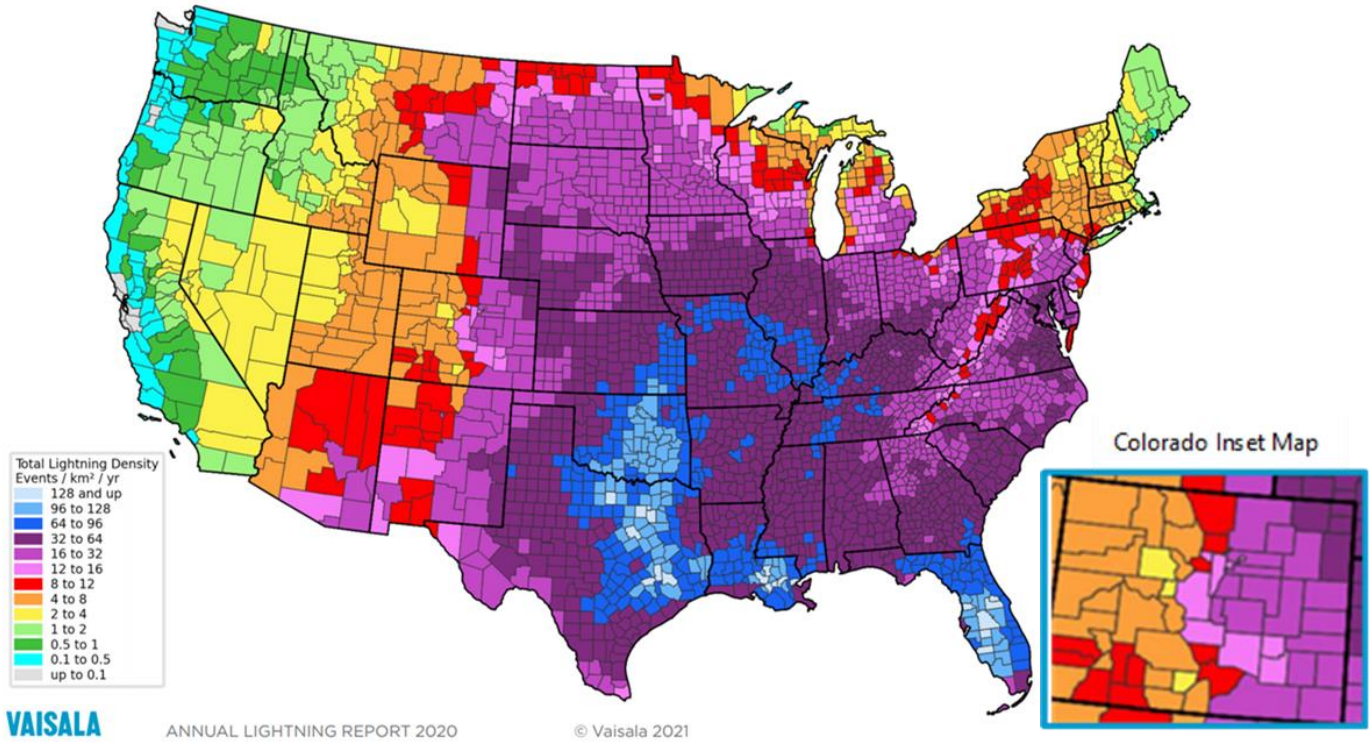
Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually, it takes place inside the cloud and looks from the outside of the

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 4-22 shows the lightning flash density for the nation. The planning area experiences 12-16 lightning events per square kilometer per year.

Figure 4-22 Average U.S. Total Lightning Density Per County, 2015-2019



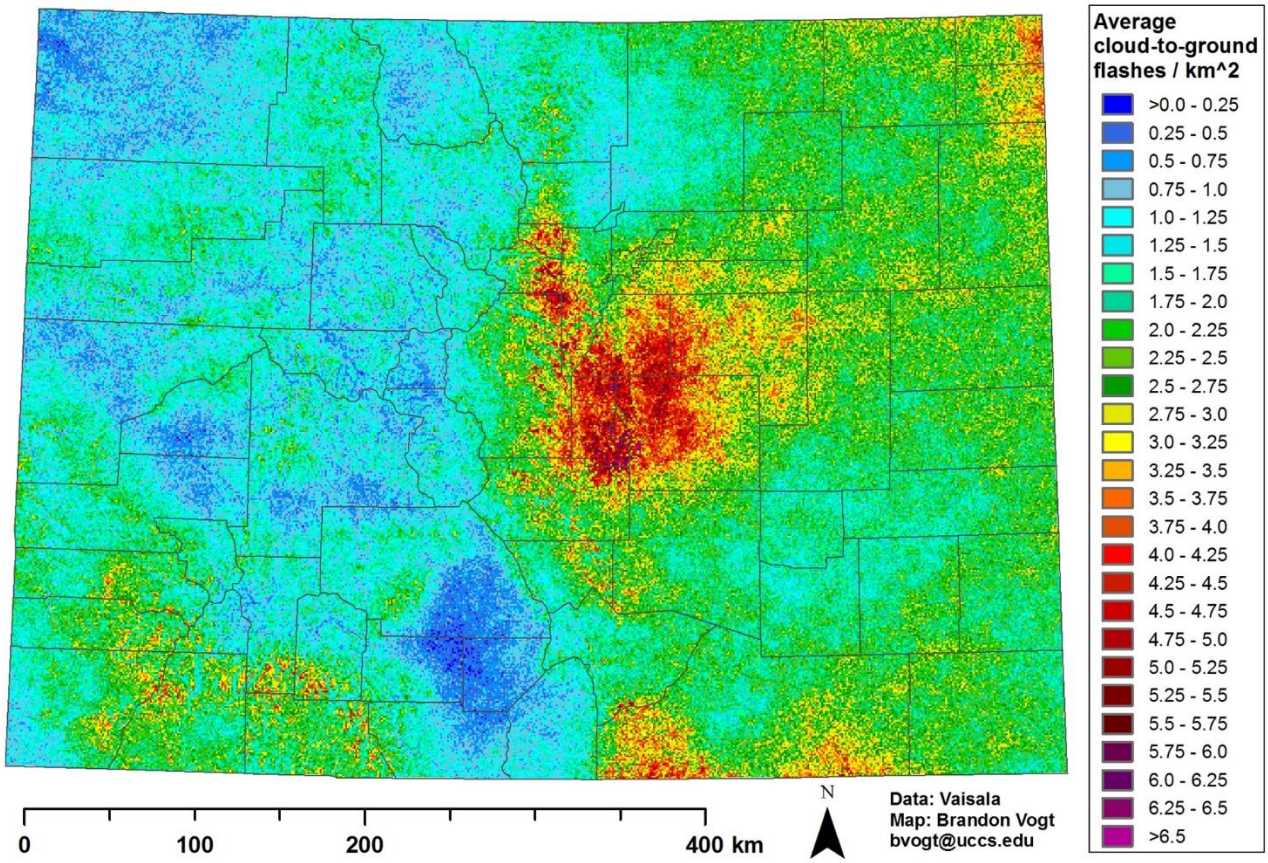
According to the Vaisala Annual Lightning Report 2020, data from the National Lightning Detection Network ranks Colorado 24th in the nation with respect to the number of cloud-to-ground strokes plus cloud pulses, with a total number of 2,401,750 counts in 2020. U.S. lightning statistics compiled by NOAA between 1959 and 1994 indicate that most lightning incidents occur during the summer months of June,

July, and August, and during the afternoon hours from between 2 p.m. and 6 p.m. 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).

Figure 4-23 shows lightning flash densities for the State of Colorado for the years 1996 through 2016. Produced by National Weather Service, using data from Vaisala, the image shows the number of Cloud to Ground (CG) lightning flashes per square kilometer per year from 1996 through 2016. This map is courtesy of Dr. Brandon Vogt, Department of Geography and Environmental Studies, University of Colorado, Colorado Springs.

Figure 4-23 Colorado Lightning 1996 – 2016: Annual



In general, the flash density map shows a wide range of values across the State of Colorado, ranging from less than 0.5 flashes/year/km2 over the south and west portions of the state to over 6.5 flashes/year/km2 over the central and central-east parts of the state. The higher density of lightning flashes located in the central area of the state is driven by the topography of the area. Where the higher terrain of the Plains intersects with the Rocky Mountains conditions are ripe for lightning events. Here, moist air from lower altitudes initiates and sustains convection systems as they move off of the mountain slopes, generating thunderstorms.

Severe Winds

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. 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.

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.

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. Although high winds are profiled here under warm weather storms, windstorms can occur the Front Range at any time of year.

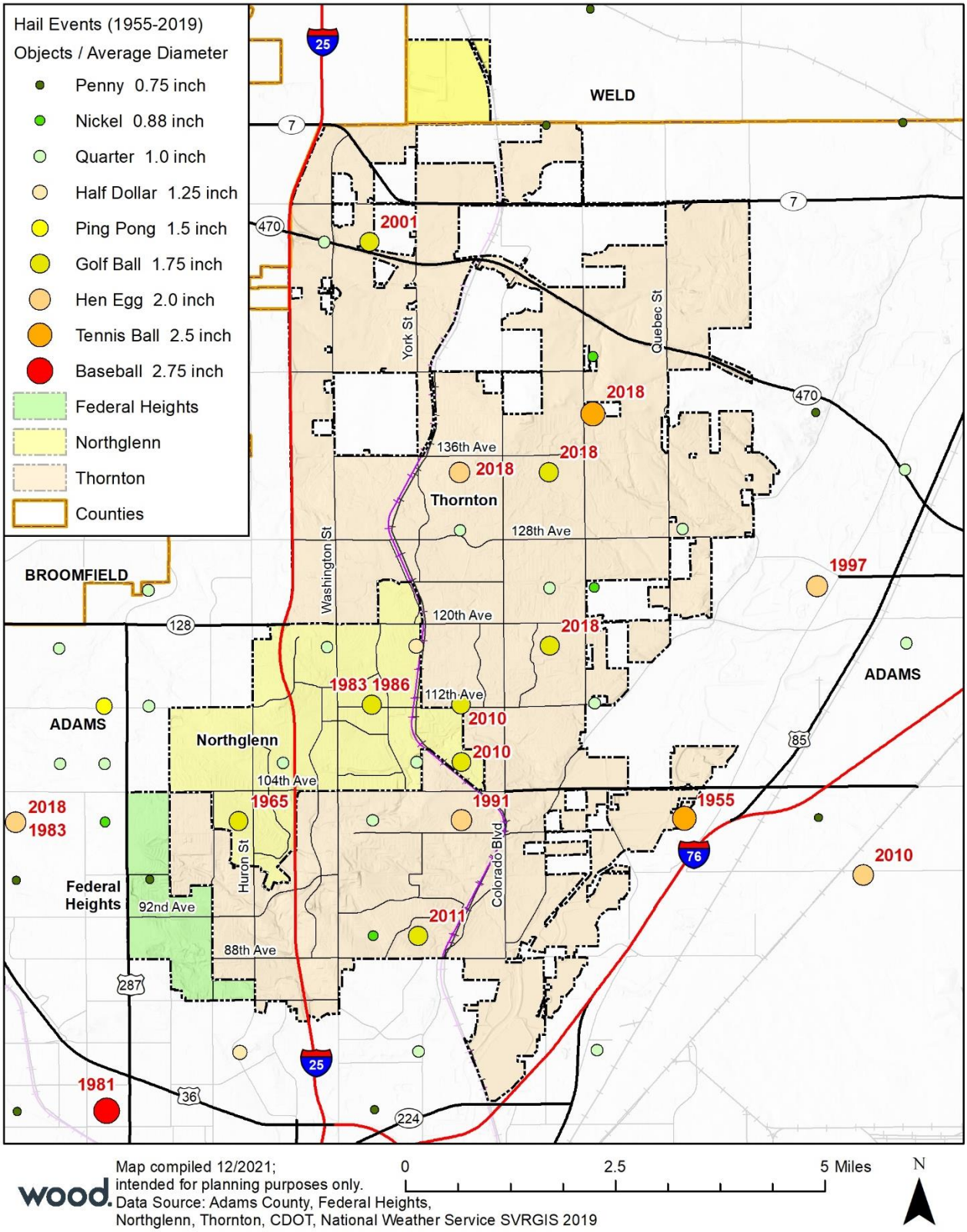
Severe storms can occur during any season in the cities of Thornton, Federal Heights, and Northglenn. Lightning strikes can all be hazardous under the right conditions and locations. Large hail stones can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people.

4.14.2 Previous Occurrences

Hail

According to NOAA there are no reported injuries, deaths, or crop damage in the Cities of Thornton, Federal Heights, and Northglenn due to hail between 1950 and 2021. There have been 20 hail events reported in the City of Thornton. Of the 20 incidents, one reported property loss of $120 million on May 22, 1996. There were 15 reported hail events in the City of Federal Heights, and 22 reported hail events in the City of Northglenn. Based on the historic data showing hazardous impacts on the cities, there is a great potential for hail events to occur at any given time.

Figure 4-24 Historical Hail Events 1955-2019



Lightning

The NCEI Storm Events Database includes no reported deaths or injuries from lightning in the Cities of Thornton, Federal Heights, or Northglenn between 1950 and 2021. However, lightning strikes occur frequently within the planning area and pose a very real threat to residents and visitors. On July 11, 2001, there was $215,000 reported in property damage in the City of Thornton due to lightning strikes. The summary of lightning events included in the NCEI database for the planning area are included in the table below.

Table 4-44 Historic Lightning Events Reported Within the Planning Area

Date	Location	Hazard Type	Injuries	Deaths	Property Damage	Crop Damage
8/29/2000	Thornton	Lightning	0	0	0	0
7/11/2001	Thornton	Lightning	0	0	$200,000	0
7/11/2001	Thornton	Lightning	0	0	$15,000	0
TOTAL:			**0**	**0**	**$215,000**	**0**

*Source: NCEI Storm Events Database (most recent record is from 2001)

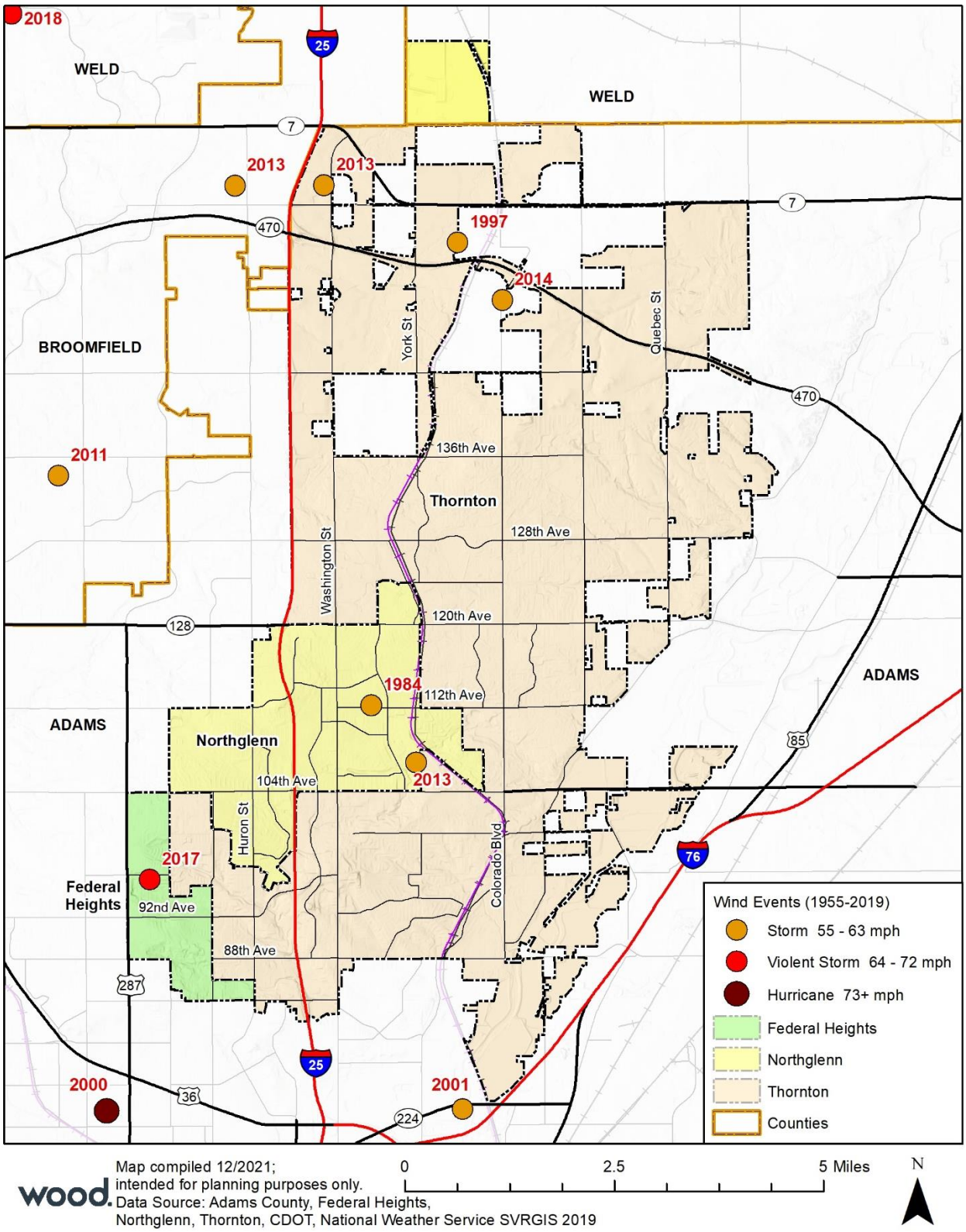
Despite the historical data showing limited impacts within the planning area, personal expertise of city staff and local stakeholders indicate that there is a great potential for hazardous lightning events to occur at any given time, especially during the spring and summer months when city residents are likely to be working and playing outdoors.

Severe Winds

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 Weld recorded 685 wind events (280 high wind, 399 thunderstorm wind, six strong wind) from 1950 to 2021. Of these events, the NCEI database indicated that there have been two thunderstorm wind events recorded for the City of Thornton, two thunderstorm wind events recorded for the City of Federal Heights and six thunderstorm wind events recorded for the City of Northglenn. None of these events resulted in any casualties or damage. The highest wind gust recorded among these ten wind events was 70.2 miles per hour on June 6, 2020, in the City of Northglenn.

Figure 4-25 shows previous high wind events in the planning area.

Figure 4-25 Cities of Thornton, Federal Heights, and Northglenn Wind Events, 1955-2019



4.14.3 Location

Thunderstorms are generally expansive in size. Any area of the three cities is susceptible to hail, lightning, or high winds. Previous instances of hail and wind events in the cities are shown in Figure 4-24 and Figure 4-25. The geographic extent is **extensive**.

4.14.4 Magnitude/Severity

Between 1986 and 2020 there were 1,020 and 1,591 watches and warnings issued by the National Weather Service in Counties of Adams and Weld respectively for severe thunderstorm (Table 4-45).

Table 4-45 Number of Severe Thunderstorm, Watches and Warnings 1986-2021

Type	Adams County	Weld County
Watch	117	135
Warning	903	1456
Total	**1,020**	**1,591**

Source: National Weather Service, Iowa Environmental Mesonet

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 4-46 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 the NCEI database had a diameter of 4.5 inches on June 4, 1983, in Weld County and also on July 13, 2011, in Adams County. The most recorded hailstone size is one inch. The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-46 indicates the hailstone measurements utilized by the National Weather Service.

Table 4-46 Hailstone Measurements

Severity	Description	Hail Diameter Size (in inches)
Non-Severe Hail Does not typically cause damage and does not warrant severe thunderstorm warning from NWS.	Pea	1/4"
	Marble/mothball	1/2"
	Penny	3/4"
	Nickel	7/8"
Severe Hail Research has shown that damage occurs after hail reaches around one inch in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from NWS.	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"
	Softball	4 1/2"

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 4-47.

Table 4-47 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

Severe Wind

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 the planning area 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. The planning area can experience all 12 Beaufort categories.

Table 4-48 Beaufort Wind Scale

Force	Wind (MPH)	World Meteorological Organization (WMO) 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 move
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: NOAA

Overall, the potential magnitude of warm-weather storms is **moderate**.

4.14.5 Probability of Future Occurrences

Severe thunderstorms are annual occurrence in the County of Adams and Weld. Atmospheric convection activity producing conditions prone to hail are expected to occur in similar frequency and extent in the future as in the past. There have been 57 recorded hail events in the three cities since 1950. This equates to a 79.2% probability of occurrence of a hailstorm in the three cities in any given year. Based on the past lightning events described under Previous Occurrences, there is a 4% probability of a damaging lightning event to occur in the three cities in any given year. In terms of severe winds, there is 13.9% annual probability of a severe event in the three cities. Based on historical records and frequencies is it **highly likely** a severe thunderstorm event will occur at least once every year.

4.14.6 Climate Change Considerations

As the atmosphere warms further due to climate change, the increased heat in the atmosphere provides more energy for 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.

4.14.7 Vulnerability Assessment

People

Although according to the NCEI, none of the hail, lighting and severe winds events has caused any casualties in the three cities, these severe weather events can still put people under risk. People can be hit by flying debris, be in building collapses, face danger while engaging in outdoor actives, etc. These severe weather events have resulted in casualties outside the planning area, as well as property and crop damage in Adams and Weld County overall.

Some segments of the population are especially vulnerable to the indirect impacts of severe thunderstorms, particularly the loss of electrical power. The highest risk demographic is to 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.

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 and Weld Counties, 12.1% and 9.2% of Medicare Beneficiaries (7,949 of 65,530 total beneficiaries and 4,886 of 53,214 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.

General 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 $2.6 billion in damages and is considered the second costliest hailstorm in U.S. 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 and Infrastructure

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 damaged. 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.

Historic, Cultural and Natural Resources

Severe thunderstorms 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, 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.

Future Land Use and Development

New critical facilities, such as communication towers should be built to withstand heavy rain damage. Future development projects should consider adverse weather hazards at the planning, engineering, and architectural design stage to reduce vulnerability. Development trends in the Cities are not expected to increase overall vulnerability to the hazard but all development will be affected by adverse weather and 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 of the cities 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.

4.14.8 Jurisdictional Differences

The impacts of severe warm-weather storms events including wind, hail, and lightning on these three cities should be similar without major differences.

In the 2017 HMP, severe warm-weather storms were rated as high significance for the Cities of Thornton and Northglenn, and medium significance for the City of Federal Heights. For the 2023 update, a closer analysis of the actual impacts of recent warm-weather storms led all three jurisdictions to rank it as medium significance.

4.14.9 Risk Summary

- The overall significance in the planning area is **medium**.
- During the 72-year period of 1950-2021, 57 hail events, three damaging lightning events and ten severe wind events happened in the three cities.
- Climate change is expected to increase the frequency of these severe weather events.
- Increased vulnerability for outdoor workers and personnel performing duties when event occurs; individuals or businesses that depended on electricity.
- Related hazards: excessive heat, flood, tornadoes and microbursts, wildfires.

4.15 Terrorism/Active Shooter

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Significant	Critical	Occasional	**Medium**
Northglenn	Significant	Critical	Occasional	**Medium**
Thornton	Significant	Critical	Occasional	**Medium**

4.15.1 Description

The FBI defines terrorism, domestic or international, as the unlawful use of force or violence against persons or property to intimidate or coerce a government or civilian population in furtherance of political or social objectives. The US State Department designates 72 groups as Foreign Terrorist Organizations around the world. There is no similar list of domestic terrorist groups. The Global Terrorism Database (GTD) maintained by the National Consortium for the Study of Terrorism and Responses to Terrorism lists 241 groups known or suspected of carrying out terrorist attacks on US soil since 1970.

Mass violence is more broadly defined as an intentional violent criminal act that results in physical, emotional, or psychological injury to a large number of people, regardless of the motivation or ideology behind the attack. Also sometimes referred to as **active threats**, mass violence can encompass a variety of malicious acts including explosive attacks, conventional firearm attacks, vehicle attacks, or even chemical/biological/ radiological/nuclear/explosive (CBRNE) attacks. The FBI defines a **mass killing** as an incident resulting in three or more fatalities. Typically, a mass violence event is a very short-lived incident meant to inflict as many casualties as possible, although recovery from an incident can last days or even months. The motivations for committing non-political acts of mass violence range from retribution for a perceived injustice; to acts of violence against minority groups; to promoting a specific social or political goal.

The FBI defines an **active shooter** as one or more individuals actively engaged in killing or attempting to kill people in a populated area. Implicit in this definition is the shooter's use of one or more firearms. The "active" aspect of the definition inherently implies the ongoing nature of the incidents, and thus the potential for the response to affect the outcome. Typically, active shooters are not interested in taking hostages or attaining material gain, and frequently are not even interested in their own survival. Unlike organized terrorist attacks, most active shooter incidents are carried out by one or two individuals. **School shootings** are a special subset of active shooter incidents.

The US Department of Homeland Security notes that "in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims…situations are unpredictable and evolve quickly...and are often over within 10 to 15 minutes." However, the presence or suspected presence of secondary devices can lengthen the duration of the event until the attack site is determined to be clear. Although this definition focuses on an active shooter, the elements remain the same for most active threat situations.

Incidents involving **weapons of mass destruction** (WMDs) are a special subset of terrorism and mass violence incidents. Such incidents may involve chemical, biological, radioactive, nuclear, or explosive (CBRNE) weapons with the potential to cause high numbers of injuries or fatalities.

Historically **explosives** have been the most common terrorist weapon, accounting for 51% of all attacks since 1970. Hazard impacts are typically instantaneous; secondary devices may be used, lengthening the duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect.

Biological terrorism is the use of biological agents against persons or property. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can be a threat for hours to years depending upon the agent and the conditions in which it exists.

Another type of biological attack is **agroterrorism**, directed at causing societal and economic damage through the intentional introduction of a contagious animal disease or fast-spreading plant disease that affects livestock and food crops and disrupts the food supply chain. Such an attack could require the agriculture industry to destroy livestock and food crops, disrupt the food supply both nationally and globally, and could also affect consumer confidence in the food supply resulting in tremendous economic damage for potentially an extended period.

Chemical terrorism involves the use or threat of chemical agents against persons or property. Effects of chemical contaminants are similar to biological agents.

Radiological terrorism is the use of radiological materials against persons or property. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

For the purposes of this hazard profile, common law enforcement incidents such as barricaded suspects, hostage negotiations, high-risk warrant searches, bomb threats, and other criminal activities are not included.

4.15.2 Previous Occurrences

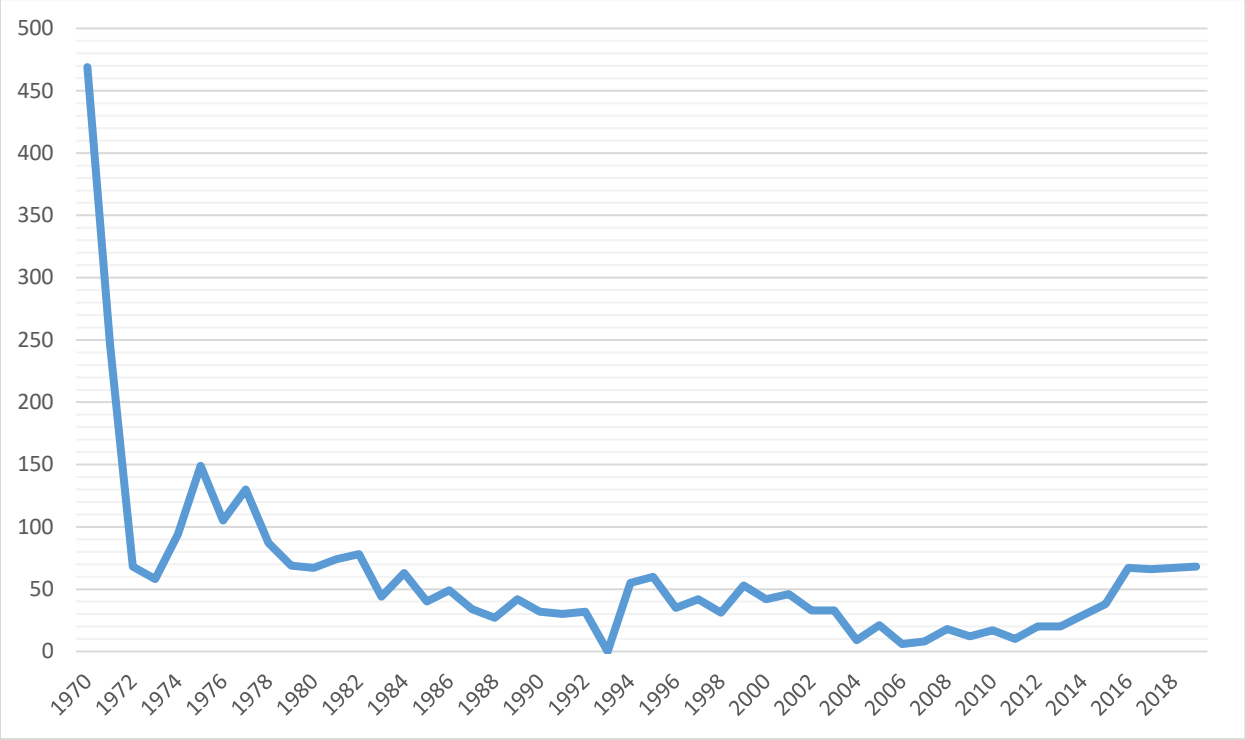
Terrorism

There have been no known incidences of terrorism in the planning area, however active shooter incidents are general threats to the community which may be considered similar to terrorism. These events place law enforcement on high alert and force portions of the planning area to be at risk until an incident can be resolved.

The GTD catalogues more than 200,000 terrorist attacks dating back to 1970. As shown in Figure 4-26, GTD data shows that despite public perception the number of terrorist attacks on US soil decreased for most of past 50 years. From an average of 148 incidents per year in the 1970s, the frequency of attacks had declined to less than 23 per year in the 2000s. An increase in attacks starting around 2014 has brought the average back up to 43 incidents per year for 2011-2019 (the most recent year the GTD has analyzed), the highest since the 1980s.

In most years, the number of people killed or injured by terrorists on American soil is fairly low, with a median of 25 casualties per year (the average is significantly higher due to a handful of high-casualty incidents such as the September 11 attacks.) According to the GTD data, there have only been 11 years since 1970 where 100 or more Americans were killed or injured in terrorist attacks; however, six of those years have been in the last 10 years.

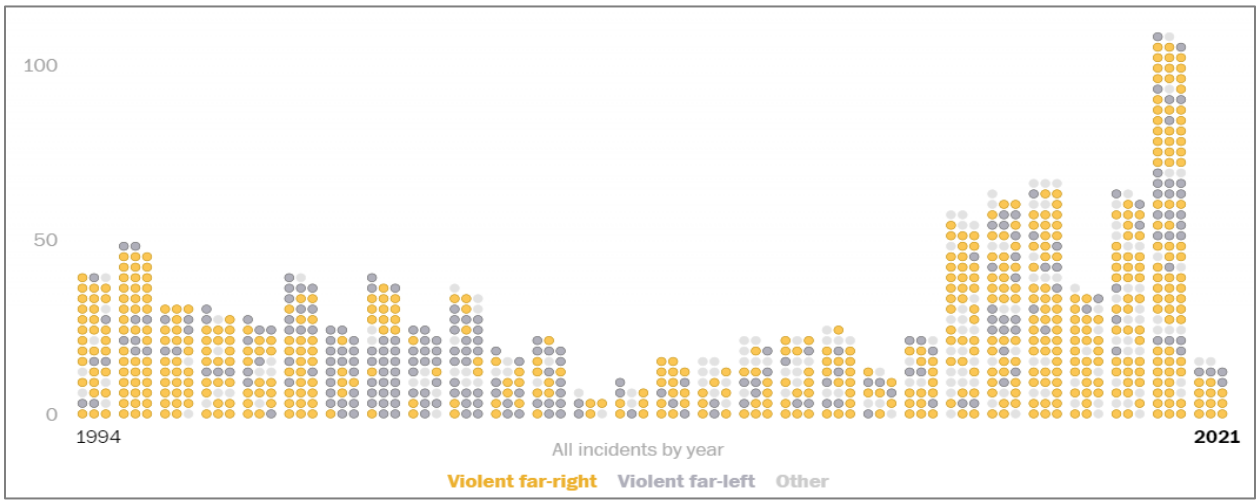
Figure 4-26 Terrorist Attacks on US Soil, 1970-2019



Source: GTD, https://www.start.umd.edu/gtd/

The increase in attacks over the last decade has been driven primarily by domestic, not international, terrorism. A recent report by the Center for Strategic and International Studies records 980 domestic terrorist attacks in the US since 1994, with sharp growth over the last 10-15 years. Figure 4-27 shows the increase in domestic terrorist attacks from 1994-2021 broken down by the ideology of the attacker. As shown in the chart, the rise in domestic terrorist attacks since 2015 has been largely driven by violent far-right groups.

Figure 4-27 Domestic Terrorist Attacks in the US, 1994-2021



Source: Center for Strategic and International Studies

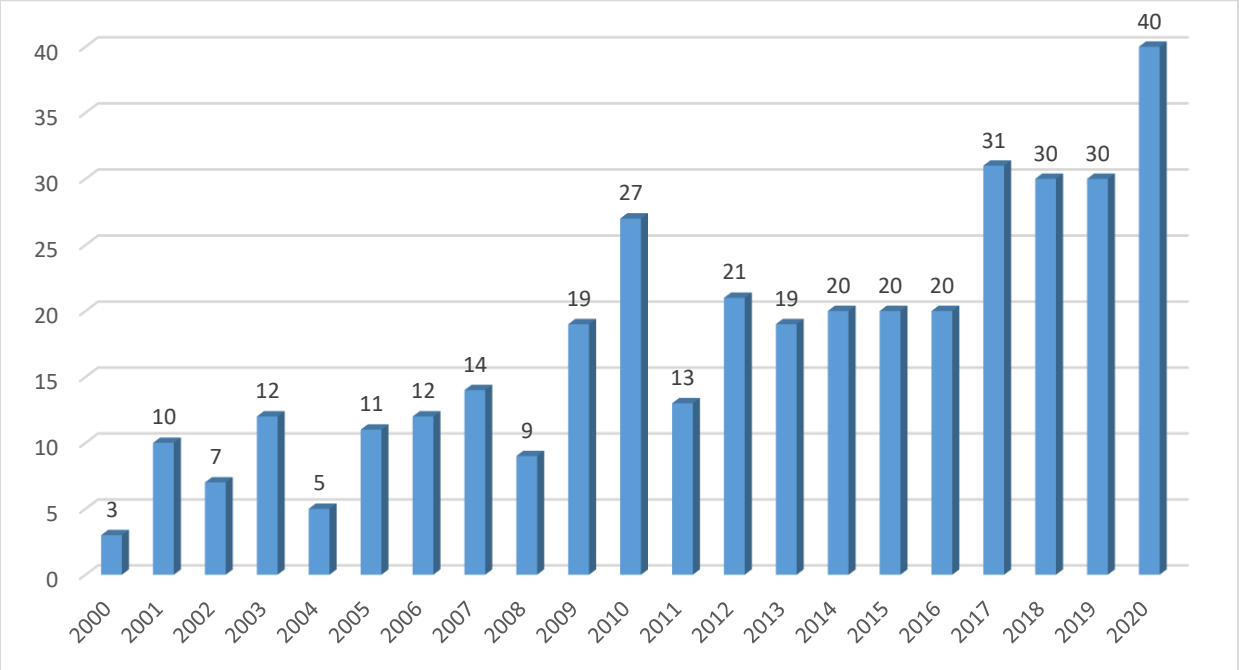
GTD data lists 24 terrorist attacks in the Denver area; however more than half of those incidents occurred during the 1970s; Denver has only seen seven attacks in the last 30 years. It is not known how many if any of those attacks took place in the planning area.

Active Shooter Incidents

The Columbine High School Shooting in 1999 was a watershed event that defined "active shooter" incidents as a hazard in the public's imagination. But even before that event, incidents that would now be called active shooter incidents have not been uncommon in the United States. Similar incidents date back to at least 1966 when a shooter at the University of Texas killed 17 individuals and wounded 31.

The FBI report Active Shooter Incidents, 20-Year Review 2000-2019 identified 333 active shooter incidents over that 20-year period. Subsequent FBI data shows 40 such incidents in 2020. These incidents are shown by year in Figure 4-28; the upward trend in the number of incidents per year is obvious from the chart.

Figure 4-28 Active Shooter Incidents in the US, 2000-2020



Source: FBI reports Active Shooter Incidents, 20-Year Review 2000-2019 & Active Shooter Incidents in the United States in 2020

The FBI report listed 13 active shooter incidents in Colorado. between 2000-2020; Colorado ranks seventh highest in number of incidents compared to other states. Table 4-49 lists active shooter incidents that have occurred in Colorado in the last 22 years. The only one of these incidents that occurred within the planning area was the 2017 Thornton Walmart shooting; however many others took place in nearby jurisdictions.

Table 4-49 Active Shooter Incidents in Colorado, 1999-2021

Year	Incident	Fatalities
1999	Columbine High School	15
2006	Platte Canyon High School	2
2007	New Life Church Shooting	4
2010	Deer Creek Middle School	0
2012	Aurora Theater Shooting	12
2013	Arapahoe High School Shooting	2

Year	Incident	Fatalities
2015	Colorado Springs Shooting	4
2017	Thornton Walmart shooting	3
2019	STEM School Shooting, Highlands Ranch	1
2021	King Soopers Shooting, Boulder	10
2021	Colorado Springs Birthday Party Shooting	7
2021	Denver/Lakewood Shooting	6

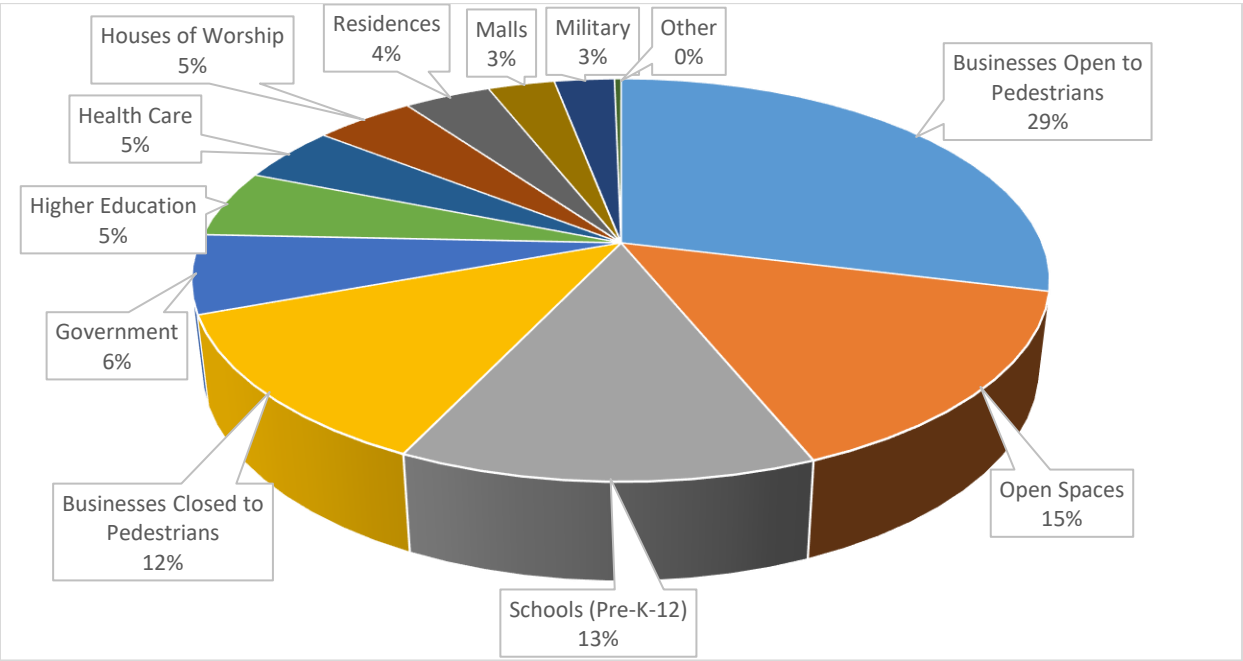
Source: News Media

School violence is sometimes considered as a subset of active shooter incidents (although not all school incidents involve the use of firearms). The US Secret Service (USSS) conducted a study of incidents of "targeted school violence" in the US from 2008 to 2017, which they defined as "any incident in which a current or recently former K-12 school student purposefully used a weapon to cause physical injury to, or the death of, at least one other student and/or school employee in or on the immediate property of the school while targeting in advance one or more specific and/or random student(s) and/or employee(s)." The study excluded spontaneous incidents that resulted from unplanned fights or were tied to other criminal acts such as gang violence or drug trafficking. The USSS study found 41 incidents that met the criteria from 2008 to 2017, an average of four per year. As with active shooter incidents, the number of school violence incidents has increased. From 2008 through 2012, the nation saw an average of 2.6 incidents per year; from 2013 through 2017, that number had risen to 5.4 per year. 61% of attacks used firearms, while 39% used knives. In the 41 attacks, 98 victims were harmed, including 79 injured and 19 killed, averaging two persons injured and zero to one killed per incident.

4.15.3 Location

Terrorism and mass violence incidents can take place anywhere. The trend in mass violence incidents has been to target high population areas, soft target venues, businesses, and schools; however, incidents across Colorado and the nation demonstrates they can happen anywhere. Figure 4-29 shows the locations targeted by 333 active shooter incidents from 2000-2019. While the entire City is potentially at risk of mass violence incidents, the geographic extent of most individual incidents is limited; an exception to this is WMD incidents, which can potentially affect large areas. Overall, the geographic extent is **significant**.

Figure 4-29 Active Shooter Incident Locations, 2000-2019



Source: FBI report Active Shooter Incidents, 20-Year Review 2000-2019

Acts of terrorism are typically a pre-meditated, targeted attack on a specific place or group such as religious or ethnic groups or sites of significant economic, strategic, military, or cultural significance. Consequently, areas of higher risk include densely populated cities and counties along the Front Range; the Denver metro area which is a densely populated transportation and economic hub of the Rocky Mountain West; Denver's government centers, including the Denver Federal Center located in Lakewood; and military facilities such as Buckley Space Force Base, Cheyenne Mountain Air Force Station (CMAFS), Peterson Air Force Base, Fort Carson, Schriever Air Force Base, the Air Force Academy, the Pueblo Chemical Depot, and Rocky Mountain Arsenal. Large venue events, such as a sporting event attended by tens of thousands of people might be considered a desirable target. Again, such events typically occur in densely populated areas since those areas are able to provide the infrastructure support (hotels, eateries, etc.) for large numbers of people. None of these specific facilities mentioned are within the planning area, but many are in very close proximity. Even a small-scale terrorist incident in one of these locations would likely cause cascading impacts to the cities of Thornton, Federal Heights, and Northglenn.

4.15.4 Magnitude/Severity

The severity of these incidents can be measured in multiple ways including length of incident, fatalities, casualties, witnesses, and number of perpetrators.

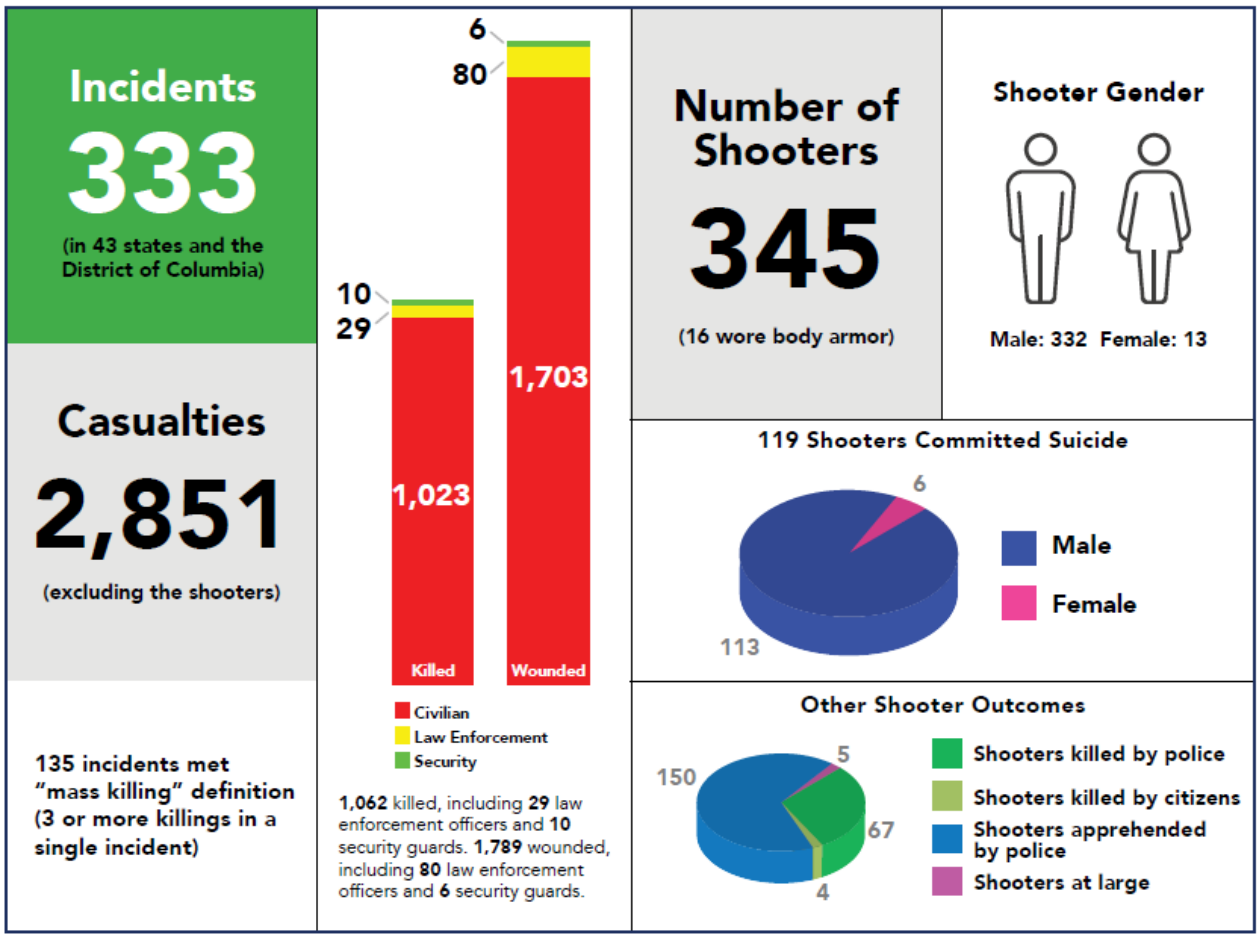
The GTD catalogues more than 200,000 terrorist attacks between 1970 and 2019 (the most recent year the GTD has analyzed). Those incidents averaged roughly one fatality and five injuries per incident. However, this data is to a large extent skewed by a handful of deadly attacks:

- The September 11, 2001, attacks on New York and Washington, DC, which killed 1,385 and injured 10,878 – more than all other terrorist attacks in the US since 1970 combined.
- The October 1, 2017, shooting at the Route 91 Harvest Festival concert in Las Vegas, Nevada, which killed 59 and wounding 851.
- The April 4, 2013, Boston Marathon Bombing killed three and injured 264.

- The April 19, 1995, bombing of the Murrah Federal Building in Oklahoma City, killing 168 and injuring 650.
- The September–October 1984 salmonella food poisoning attack in Dalles, Oregon, which sickened 751 people.
- These five attacks account for 64% of the fatalities and 87% of the injuries from terrorist attacks in the US. Roughly 80% of recorded terrorist attacks result in no fatalities or injuries.

Figure 4-30 summarizes the outcomes of 333 active shooter incidents in the US from 2000-2019 studied by the FBI. Casualties for active shooter incidents vary widely, with an average of three killed and five wounded per incident, excluding the shooter.

Figure 4-30 Active Shooter Incident Outcomes, 2000-2019



Source: FBI report Active Shooter Incidents, 20-Year Review 2000-2019

Although an active threat may only directly impact one specific piece of infrastructure (e.g., a school, theater, or concert venue), it indirectly impacts the community in many ways, including ongoing closures for investigation, local and national media logistics, VIP visits, mental health concerns, need for additional support services, avoidance of similar infrastructure, and subsequent impacts to businesses. The psychological impact is often much worse than the direct impacts and can continue to affect a community for years. Thus, the overall significance of this hazard is **critical**.

4.15.5 Probability of Future Occurrences

The probability of a terrorist or active shooter attack can be difficult to quantify, largely due to different definitions and data collection methods. According to Maplecroft Terrorism Dashboard (MTD) data, there have been 630 terrorist attacks in the US from 2000-2019, an average of 31 per year. Of those attacks, 184 resulted in fatalities or injuries, for a national average of nine per year. The Denver metro area has experienced seven terrorist attacks in the last 30 years, for an average of one every four years.

The 373 active shooter incidents in the FBI report average out to 17.8 incidents per year between 2000-2020; but the increased frequency of incidents means the average for 2011-2020 is actually 24.4 per year. Based on the 13 incidents in Colorado from 2000-2020, there is roughly a 62% chance of an active shooter incident occurring somewhere in the State each year. While the odds of an attack specifically in the planning area are significantly lower, it should be noted that attacks in neighboring counties can still have significant impacts throughout the area. The overall probability is estimated to be **occasional**.

4.15.6 Climate Change Considerations

There is no established link between climate change and human-caused hazards such as active shooters.

4.15.7 Vulnerability Assessment

People

Most terrorist attacks are primarily intended to kill and injure as many people as possible. Physical harm from a firearms attack or explosive device is not completely dependent on location, but risk is greater in areas where higher numbers of people gather. If a biological or chemical agent were released indoors, it could result in exposure to a high concentration of pathogens, whereas an outdoors release could affect many more people but probably at a lower dose. Symptoms of illness from a biological or chemical attack could go undetected for days or even weeks. Local healthcare workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack would likely cause significant stress and anxiety.

Similarly, most active shooters primarily target people, attempting to kill or injure large numbers of individuals. The number of injuries and fatalities are highly variable, dependent on many factors surrounding the attack including the location, the number of type of weapons used, the shooter's skill with weapons, the amount of people at the location, and law enforcement response time. Psychological effects of the incident, on not only victims and responders but also the general public, may last for years.

General Property

The potential for damage to property is highly dependent on the type of attack. Terrorist attacks involving explosives or other weapons, may damage buildings and infrastructure. For most attacks, impacts are highly localized to the target of the attack, although attacks could potentially have much broader impacts. Active shooter incidents rarely result in significant property damage, although crime scene measures may deny the use of targeted facilities for days after the incident.

Critical Facilities and Infrastructure

Impacts to critical infrastructure would depend on the site of the attack. Short or long-term disruptions in operations could occur, as well as gaps in continuity of business or continuity of government, depending on who the victims of the attack are, and whether a continuity plan is in place. While active shooter incidents rarely cause major property damage directly, indirect effects can be significant, such as the loss of critical facilities for days or weeks due to crime scene concerns.

Additionally, both terrorism and active shooter incidents can result in a drain on first responder resources and personnel for days to weeks following the incident.

Economy

Active shooter or terrorist incidents could have significant economic impacts. Specific examples could include short-term or permanent closing of the site of the attack. Another economic impact could be caused by general fear – as an example, an attack in a crowded shopping center could cause potential patrons to avoid similar places and disrupt economic activity. Potential economic losses could include cost of repair or replacement of damaged facilities, lost economic opportunities for businesses, loss of food supplies, disruption of the food supply chain, and immediate damage to the surrounding environment.

As an extreme example, after the September 11, 2001, terrorist attacks in New York and Washington the U.S. stock market lost $1.4 trillion, the Gross Domestic Product of New York City lost an estimated $27 billion, and commercial air travel decreased by 20%.

Historic, Cultural and Natural Resources

Generally, active shooter incidents would not have an impact on the natural environment. Agro-terrorism or chemical terrorism could result in significant damage to the environment in areas near the attack. These events can pollute the environment and cause nearby plants and animals to get sick or die. Contaminated material that gets into the air or water supply can affect humans further away from the incident site. Additionally, terrorists have been known to target sites with historic or cultural significance.

Land Use and Development

The link between increased development and terrorist attacks is uncertain at best. Many terrorist attacks have targeted larger metropolitan areas, so a larger population could potentially make public events more attractive targets. Population growth and development could expose more people and property to the impacts of an explosive or other large-scale attack.

Depending on the motivation behind the attack, incidents will most likely be focused on so-called "soft targets." Protective design of buildings can reduce the risk of an active shooter incident, and if one occurs, can mitigate, or reduce the impacts and number of potential victims.

4.15.8 Jurisdictional Differences

The degree of vulnerability to terrorism or active shooter events does not vary greatly amongst the three cities in the planning area. Anywhere that people congregate could potentially become the site of a terrorist or shooting attack. Each city is home to commercial or cultural sites, such as grocery stores, offices, hospitals, restaurants, government buildings, and schools, which have all been shown to be targets of these events in the past. While terrorism events will largely be responded to by the State and Federal forces, response and recovery efforts specific to active shooter events should be developed to some degree at the municipal level.

The risk of terrorism or active shooter events was not profiled in the 2017 HMP.

4.15.9 Risk Summary

- This hazard's overall significance is ranked **medium**.
- While the number of terrorist attacks on U.S. soil has been declining since the 1970s, active shooter incidents and school violence have risen sharply in recent years.
- Effects on people: The primary aim of most active shooters is to injure/kill as many people as possible.
- Effects on property: Active shooter incidents rarely cause significant property damage.
- Effects on economy: Most active shooter incidents have minimal impacts on the economy.
- Effects on critical facilities and infrastructure: Crime scene concerns can lead to the loss of use of critical facilities for days or weeks.
- Related Hazards: cyber attack, hazardous materials

4.16 Tornado and Microburst

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Limited	Moderate	Likely	**Medium**
Northglenn	Limited	Moderate	Likely	**Medium**
Thornton	Limited	Moderate	Likely	**Medium**

4.16.1 Description

Tornadoes

Tornadoes are the most intense storm on earth, with wind speeds having been recorded at over 315 mph. The phenomena result in a destructive rotating column of air ranging in diameter from a few yards to greater than a mile, usually associated with a downward extension of cumulonimbus clouds. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can form from individual cells within severe thunderstorm squall lines. They also can form from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

The U.S. experiences more tornadoes than any other country. In a typical year, approximately 1,000 tornadoes affect the U.S. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S. Figure 4-35 below section shows the annual average number of tornadoes between 1991 and 2015. Colorado experienced an average of 49.5 tornado events annually in that period. Colorado ranks ninth among the 50 states in frequency of tornadoes, but 38th for the number of deaths. Nationwide, Colorado ranks 31st for injuries and 30th for the cost of repairing the damages due to tornadoes. When these statistics are compared to other states by the frequency per square mile, Colorado ranks 28th for injuries per area and 37th for costs per area.

Tornadoes form when cool, dry air sits on top of warm, moist air. In Colorado, this most often happens in the spring and early summer (i.e., May, June, and July) when cool, dry mountain air rolls east over the warm, moist air of the plains during the late afternoon and early evening hours. However, tornadoes are possible anywhere in the state, at any time of year and at any point during the day.

Tornado wind speeds can range between 30 to more than 300 miles per hour. Most tornadoes are a few dozen yards wide and touch down briefly, but even small, short-lived tornadoes can inflict tremendous damage. 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 necessary emergency response.

Microbursts

Severe Wind can also occur outside of tornadoes, severe storms, and winter storms. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems (one high pressure, one low pressure) are, the stronger the pressure gradient, and therefore, the stronger the winds are.

Straight-line winds, which can cause more widespread damage than a tornado, occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, or when an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A microburst is a small, concentrated downburst that produces and outward burst of strong winds at the surface; they are generally short lived lasting between five and ten minutes with maximum windspeeds that sometimes exceed 100 mph. There are two types of microbursts: a wet microburst is accompanied by heavy precipitation at the surface and a dry microburst, common in the high plains and intermountain west, occur with little or no precipitation reaching the ground. A "derecho" is a series of downbursts associated with a line of severe storms.

4.16.2 Previous Occurrences

Colorado, lying just west of "tornado alley," is fortunate to experience less frequent and intense tornadoes than its neighboring states to the east. However, tornadoes remain a significant hazard in the region.

Figure 4-31 June 3, 1981, Tornado Damage Along Washington Street (Source: City of Thornton)



The NCEI storm events database records 438 tornado events across 262 days in Adams and Weld counties. The following table summarizes tornado history and damage data for the cities of Thornton and Northglenn from 1950 – 2021 collected by the NOAA Storm Prediction Center and NCEI storm events database. There are no historical tornado touchdowns recorded for the City of Federal Heights.

Figure 4-32 depicts historical tornado tracks and events in and around the cities of Thornton, Federal Heights, and Northglenn. The map illustrates where tornadoes have touched down (and where they traveled) between 1954 and 2015.

Figure 4-32 Historical Tornado Events in the Planning Area

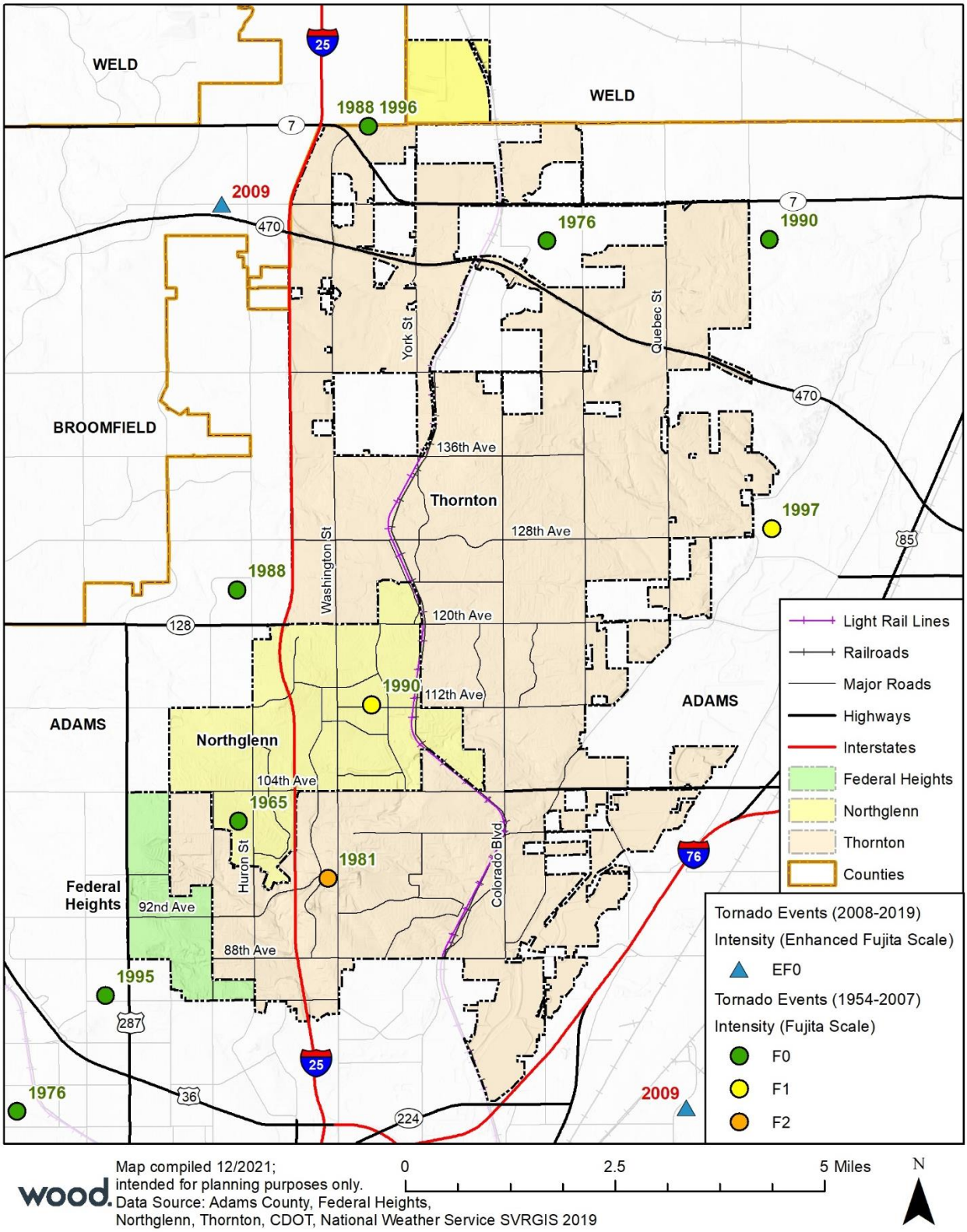


Table 4-50 Tornado History in The Cities of Thornton and Northglenn (1954-2021)

Date	Location	EF scale	Injuries	Deaths	Estimated Property Damage	Estimated Crop Damage
06/30/1965	Northglenn	0	0	0	0	0
06/03/1981	Thornton	2	42	0	7,000*	0
06/05/1988	Thornton	2	0	0	5,000	0
05/29/1990	Northglenn	1	0	0	5,000	0
06/01/1990	Thornton	0	0	0	0	0
06/22/1996	Thornton	0	0	0	0	0
06/22/1997	Thornton	1	0	0	0	0
06/07/2009	Northglenn	0	0	0	$25,000	$0
	TOTALS:		**42**	**0**	**$42,000**	**0**

Source: NOAA; NCEI Storm Events Database
*Media sources have reported over $50 million in damage due to this tornado event.

Incidences of severe wind (high wind, thunderstorm wind, and strong wind) can be found in Section 4.14. NCEI does not record microburst events, but the National Weather Service estimates there are approximately 10 microbursts for every one tornado.

4.16.3 Location

Tornadoes are possible anywhere in Colorado, even in mountainous terrain. In 2007, a tornado damaged thousands of trees outside of Woodland Park in Pike National Forest in Teller County. Another tornado in Clear Creek County in 2012 is one of the highest elevation tornadoes ever recorded, touching down at approximately 11,900 feet above sea level. The severe weather conditions that spawn tornadoes are regional events which may impact any extent of the planning at a given time, and in this regard, the possible geographic extent for tornadoes is extensive. However, tornadoes as a stand-alone event are single-point (or limited point) occurrences similar to lightning. While knowing that the entire planning area is vulnerable to a tornado, the realistic assessment of tornado occurrences indicates that these single point events occur in a negligible density. An average of the two extremes may yield the most likely extent rating.

Based on this information, the geographic extent rating for tornadoes is **limited.**

4.16.4 Magnitude/Severity

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, the less spectacular damage is much more common.

Tornadoes were previously classified by their intensity using the Fujita (F) Scale, with FO being the least intense and F6 being the most intense. The Fujita Scale was used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a manmade structure. On February 1, 2007, the Fujita scale was decommissioned in favor of the more accurate Enhanced Fujita Scale (aka the EF Scale). The EF-Scale is a set of wind estimates (not measurements) based on damages. It classifies tornadoes into six intensity categories, as shown in the following table. The scale was revised to reflect better examinations of tornado damage surveys, so as to align wind speed estimates more closely with

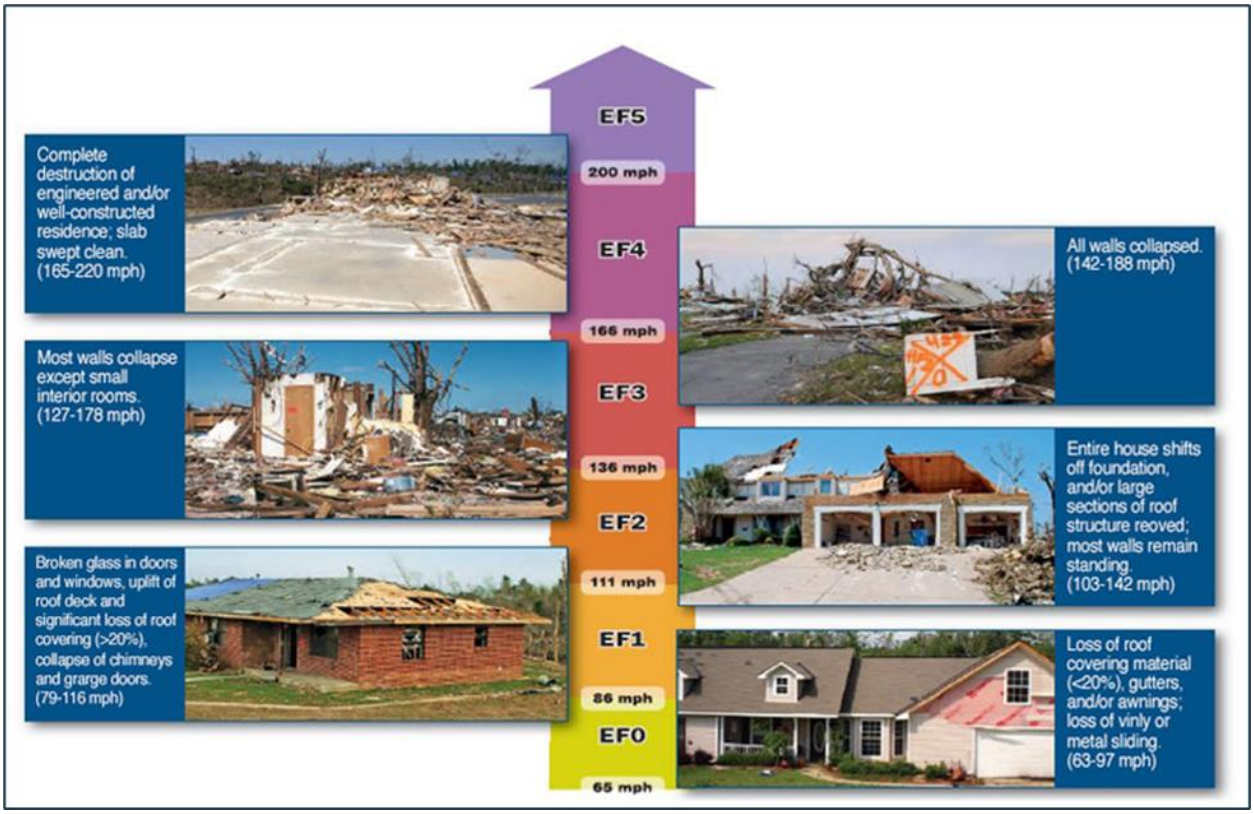
associated storm damage. The new scale takes into account how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Figure 4-33 illustrates potential damages from each level of the EF scale.

Table 4-51 Enhanced Fujita (EF) Scale

Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown, and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Association

Figure 4-33 Potential Damage Impacts from a Tornado



Source: National Oceanic and Atmospheric Administration

The magnitude and severity rating for this hazard is **moderate**.

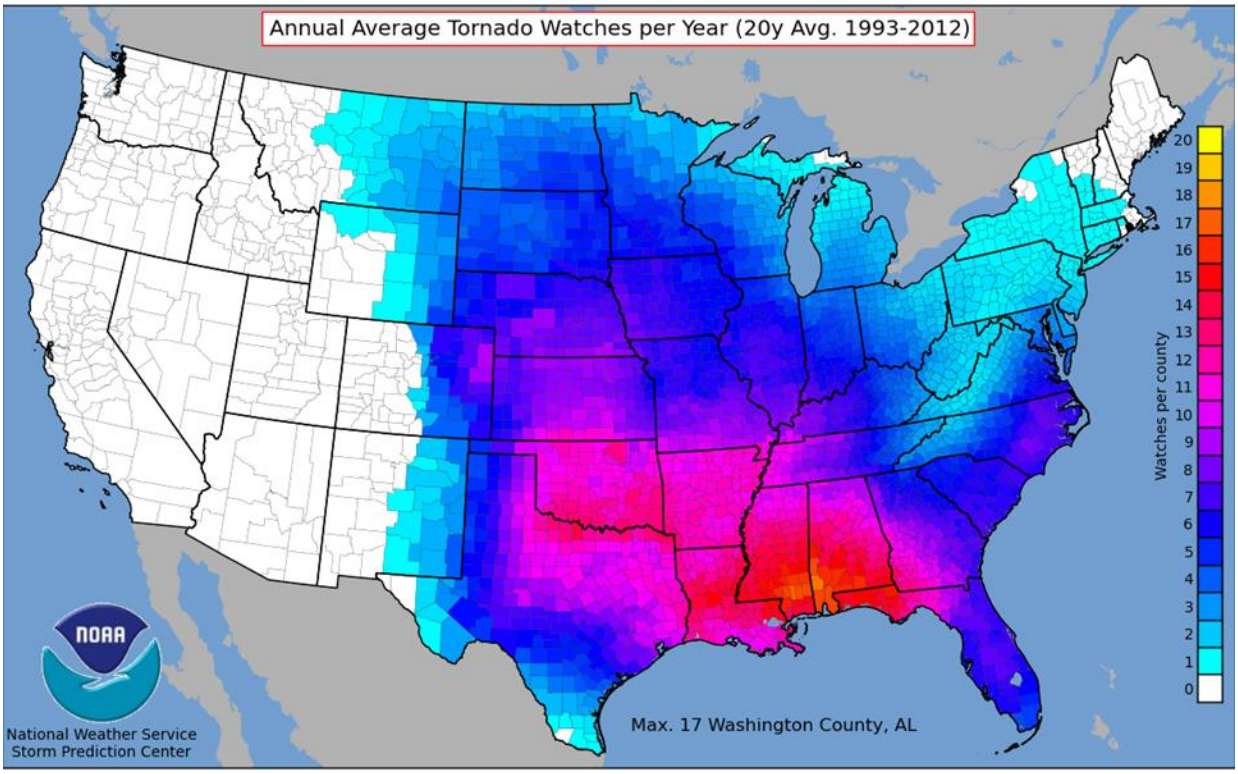
4.16.5 Probability of Future Occurrences

The NOAA's storm prediction center issues tornado watches and warnings nationwide:

- **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.

A study from NOAA's National Severe Storms Laboratory used historical data to estimate the daily probability of tornado occurrences across the U.S., regardless of tornado magnitude. Figure 4-34 shows the estimates. The density per 25 square miles in the map's legend indicates the probable number of tornadoes for each 25 square mile cell within the contoured zone that can be expected over a similar period of record. It should be noted that the density number does NOT indicate the number of events that can be expected across the entire zone on the map.

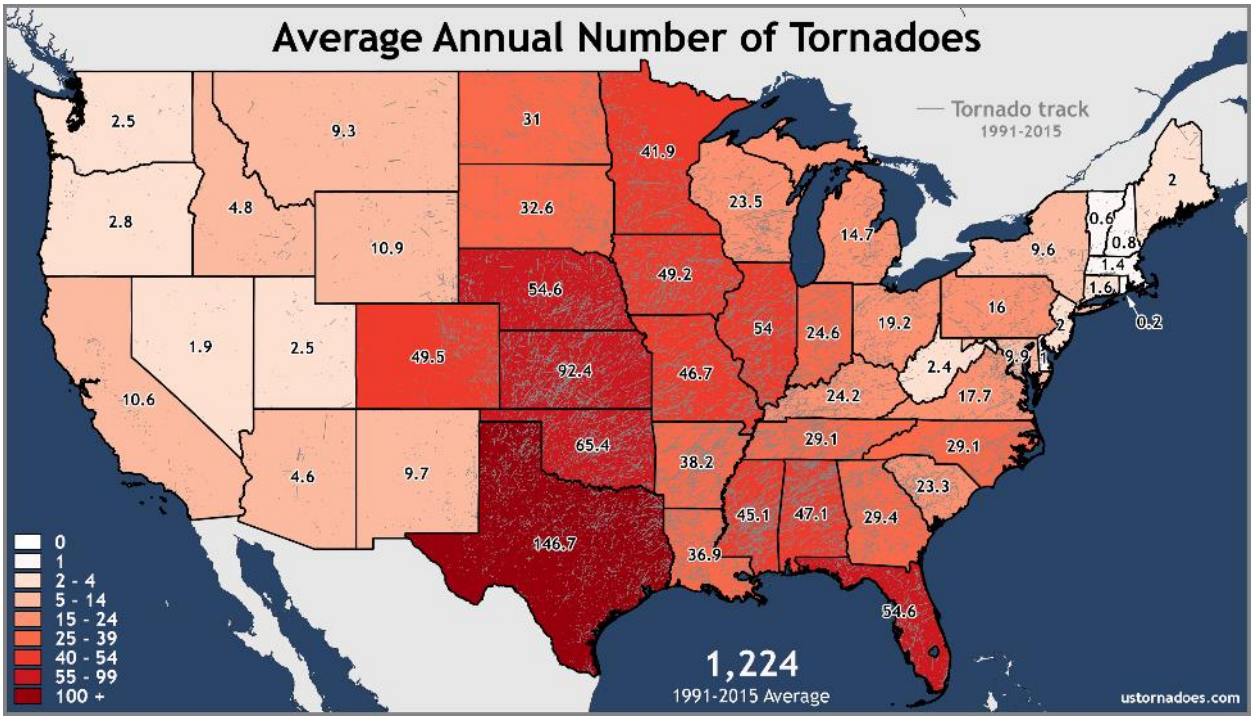
Figure 4-34 Total Annual Tornado Watches in the U.S. (1993-2012)



Source: National Oceanic and Atmospheric Administration

Figure 4-35 below shows the average number of recorded tornadoes per year in each state from 1991 to 2015. Tornadoes have been reported nine months of the year in Colorado, with peak occurrences between May and August. Statewide, June is by far the month with the most recorded tornadoes. There have been eight recorded tornadoes between 1950 and 2021, therefore, there is a 11% chance in any given year for a tornado in the planning area. Based on this, the probability of future occurrence rating for tornadoes is **likely.**

Figure 4-35 Annual Average Number of Tornadoes in the U.S. (1991-2015)



Source: U.S. Tornadoes

4.16.6 Climate Change Considerations

Climate change impacts on the frequency and severity of tornadoes are unclear. NASA's Earth Observatory has conducted studies which aim to understand the interaction between climate change and tornadoes. Based on these studies meteorologists are unsure why some thunderstorms generate tornadoes and other do not, beyond knowing that they require a certain type of wind shear. Tornadoes spawn from approximately one percent of thunderstorms, usually supercell thunderstorms that are in a wind shear environment that promotes rotation. Some studies show a potential for a decrease in wind shear in mid-latitude areas. The level of significance of this hazard should be revisited over time.

4.16.7 Vulnerability Assessment

People

Vulnerable populations are the elderly, low income, or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard. Approximately 9% of Medicare Beneficiaries in Weld County and 12% in Adams County rely on electricity-dependent medical equipment to be able to live independently in their homes.

Individuals caught in the middle of the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or who do not have access to basements, cellars, or safe rooms.

General Property

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may be at risk to the most damage. Mobile homes are more vulnerable to the

impacts of a tornado event compared to other housing types due to the methods of construction. Statewide, mobile homes represent about 4% of total housing units, and 44.6%, 0.4%, and 6.2% of housing units in Federal Heights, Northglenn, and Thornton, respectively. If an EF3 or higher tornado were to hit the densely populated parts of the planning area, the damage to property would likely be substantial.

Secondary impacts of damage caused by tornado events often result from damage to infrastructure. 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. In the immediate aftermath, the focus is on emergency services.

Critical Facilities and Infrastructure

All critical facilities and infrastructure are likely exposed to tornadoes, though the likelihood of damage to any critical facilities or infrastructures from a tornado is extremely limited. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

Tornadoes can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Any facility that is in the path of a tornado is likely to sustain damage.

Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure is damaged that houses such materials or if such a material is in transport.

Economy

Tornadoes can impact exposed critical infrastructure; depending on the impact and the function, this could cause a short-term economic disruption. The most common problems associated with tornadoes and damaging winds are loss of utilities. Downed power lines can cause power outages, leaving large parts of the planning area isolated, and without electricity, water, and communication. Damage may also limit timely emergency response and the number of evacuation routes. Downed electrical lines following a storm can also increase the potential for lethal electrical shock and can also lead to other hazard events such as wildfires.

Historic, Cultural and Natural Resources

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado. However, if tornadoes impact facilities that store HAZMAT, areas impacted by material releases may be especially vulnerable. Historic buildings built prior to modern building codes would be more prone to damage

Land Use and Development

All future development will be potentially exposed to tornadoes. Development regulations that require safe rooms, basements, or other structures that reduce risk to people would decrease vulnerability but may not be cost-effective given the relative infrequency of damaging tornadoes in the planning area.

4.16.8 Jurisdictional Differences

Due to the nature of tornado events, risk does not vary significantly across jurisdictions.

In the 2017 HMP, tornadoes and microbursts were rated as high significance for the Cities of Thornton and Federal Heights, and medium significance for the City of Northglenn. For the 2023 update, a closer

analysis of the actual frequency and impacts of tornadoes and microbursts in the planning area led all three jurisdictions to rank it as medium significance.

4.16.9 Risk Summary

- The overall significance of tornadoes and microbursts in the planning area is **medium**.
- Between 1950 and 2021 there were eight tornado events in the planning area. Most occurred in Thornton (5) followed by Northglenn (3). No events were recorded as taking place in Federal Heights in that time period.
- There is an 11% chance a tornado event will occur in the planning area in a given year.
- In total past events have resulted in $42,000 in property damages.
- Recorded total injuries (42) resulted from one event on June 3, 1981. An F2 tornado is the greatest magnitude tornado recorded. F0 is the most commonly recorded.
- Related Hazards: Severe Warm-Weather Storms.

4.17 Wildland Fire

Jurisdiction	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Federal Heights	Limited	Moderate	Likely	**Low**
Northglenn	Significant	Moderate	Likely	**Medium**
Thornton	Significant	Moderate	Likely	**Medium**

4.17.1 Description

Wildfires are defined as unwanted or unplanned wildland fires. They include unauthorized human caused fires, ignited by activity such as smoking, campfires, equipment use, or arson, escaped prescribed burn projects, and all other wildland fires where the objective is to put the fire out. Wildfires may also be the result of a lightning strike.

Wildfires pose serious threats to human safety and property in the cities of Thornton, Federal Heights, and Northglenn. Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Prolonged wildfires may also increase air pollution in the immediate and surrounding areas, impacting human health. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exist in areas designated as wildland urban interface (WUI) areas, where development is adjacent to densely vegetated areas.

Wildfires are sustained by three major factors: fuel, topography, and weather as defined below.

- **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, leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses; fuels can be both native and non-native species. Structures such as homes and associated combustibles are also potential fuel sources. 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. “Ladder fuels” are fuels low to the ground that can spread a surface fire upward through brush and into treetops. These fires, known as crown fires, burin in the upper canopy of forests and are nearly impossible to control. The volume of available fuel is described in terms of fuel loading. Arrangement is another important aspect of fuel. Arrangement influences the availability of oxygen surrounding the fuel source. Another important aspect of fuel quality is the total surface area of the material that is exposed to heat and air. Fuels with large area-to-volume ratios, such as grasses, leaves, bark, and twigs, are easily ignited when dry.
- **Topography**: An area’s terrain and land slopes affect its susceptibility to wildfire spread. Both the fire intensity and the rate of spread increase as slop increases due to the tendency of heat from a fire to rise via convection. The arrangement and types of vegetation throughout a hillside can also contribute to increased fire activity on slopes. In addition, topography impacts the ability of firefighters to combat the blaze by hampering access for equipment, supplies, materials, and personnel.
- **Weather**: Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfires. High temperatures and low relative humidity dry out the fuels that feed the wildfire, increasing the odds that fuel will more readily ignite and burn more intensely. Wind is the most treacherous weather factor. The greater the wind, the faster a fire will spread and more intense it will be. In addition to wind speed, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. Lightning may also

ignite wildfires, which are often in terrain that is difficult for firefighters to reach. Drought conditions contribute to wildfire vulnerability and susceptibility. During periods of drought, low fuel moisture and lack of precipitation increase the threat of wildfire. There is no known effective measure for human mitigation of weather conditions. Careful monitoring of weather conditions that drive the activation and enforcement of fire-safety measures and programs, such as bans on open fires, are ongoing weather-related mitigation activities.

It is estimated that 80% to 90% of wildfires are started by human activity, which can include neglected campfires, sparks from power lines, equipment and vehicles, or deliberate arson. Human-caused wildfires are typically worse than those caused by natural agents. Arson and accidental fires usually start along roads, trails, streams, or at dwellings that are generally on lower slopes or bottoms of hills and valleys. Nurtured by updrafts, these fires can spread quickly uphill. Arson fires are often set deliberately at times when factors such as wind, temperature, and dryness contribute to the spread of flames.

Wildfires are of significant concern throughout Colorado. According to the Colorado State Forest Service, vegetation fires occur on an annual basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and become wildfires, damage can be extensive. According to the 2018 State of Colorado Hazard Mitigation Plan, a century of aggressive fire suppression combined with cycles of drought and changing land management practices has left many of Colorado's forests unnaturally dense and ready to burn. Further, the threat of wildfire and potential losses is constantly increasing as human development and population increases and the Wildland Urban Interface (WUI) expands. Another contributing factor to fuel loads in the forest are standing trees killed by pine bark beetles, which have been affecting the forests of Colorado since 2002, becoming more widespread and a serious concern.

Wildland fires also contribute to poor air quality in the planning area, again impacting human health and the environment. In addition, fires can severely damage forested areas and watersheds that are critical to the planning area's drinking water supply. Catastrophic wildland fires have a high probability of occurring in certain forest types that are unhealthy due to tree density. In 1996 and 2002, two major wildland fires occurred above Denver Water's reservoirs. Subsequent rain events resulted in significant erosion, transporting large volumes of sediment into these water supply reservoirs. The sediment impacted quality of the water supply that required increased water treatment and management costs, and a reduction in storage capacity

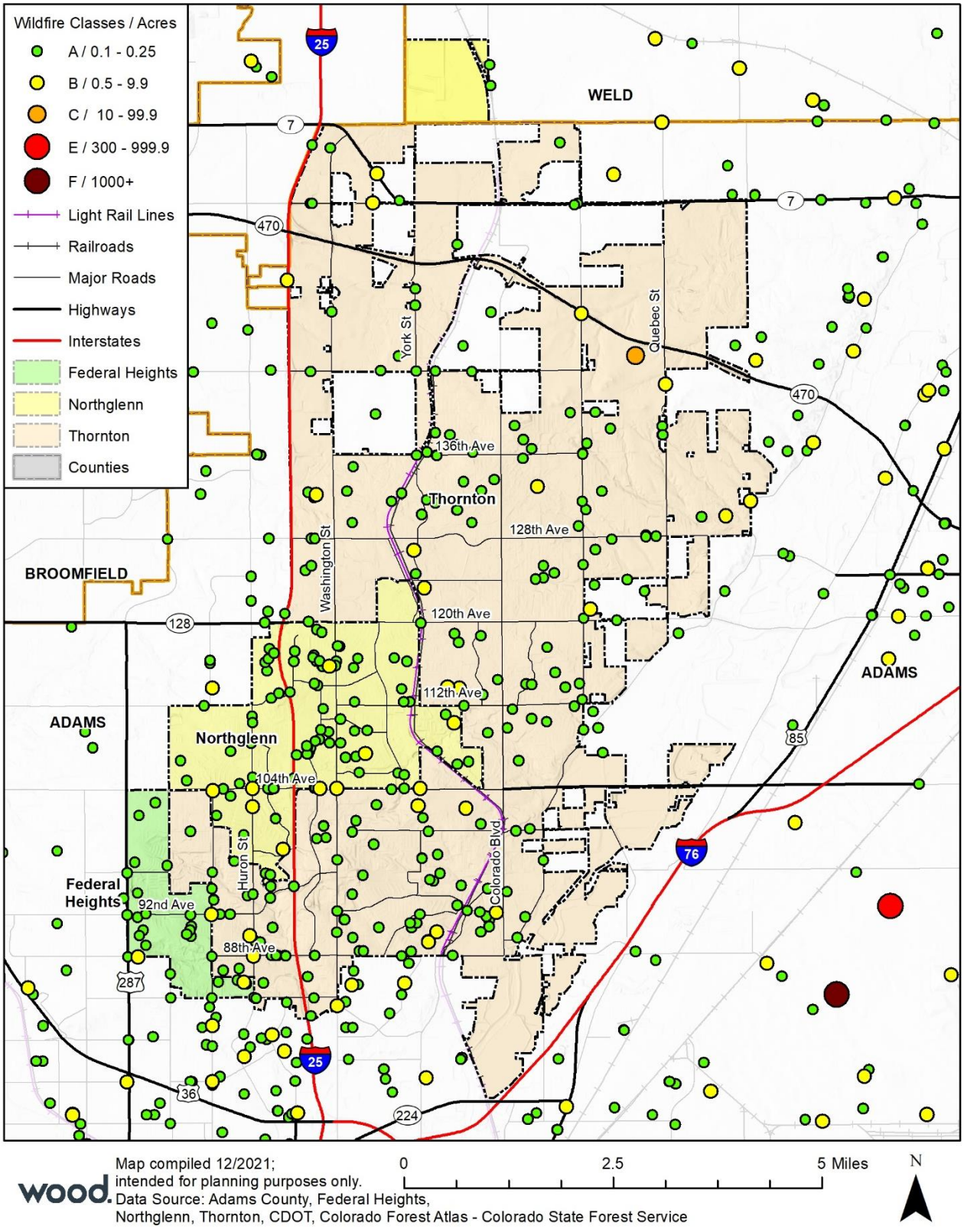
4.17.2 Previous Occurrences

According to the NCEI Storm Events Database there have been no historic wildfire events recorded in the Cities of Thornton, Federal Heights, and Northglenn. However, wildland fires have the potential to threaten people and property on the outskirts of the planning area. As continued population growth pushes community assets into wildland-urban interface areas new challenges will be presented to Front Range communities.

Figure 4-36 shows the locations of past wildfire and brushfire events in and around the planning area.

The 2021 Marshall Fire demonstrates how destructive grass fires can be when they spread to an urban area. A brush fire broke out in Boulder County following months of unusually warm and dry conditions. Driven by high winds with gusts up to 115 mph, the fire quickly spread to the Town of Superior and the City of Louisville. Thousands of people were forced to evacuate. The fire destroyed 1,084 homes and seven businesses and damaged another 149 homes and 30 businesses; total estimated damages were $513M as of January 7, 2022. At least one person was killed, and six others were injured.

Figure 4-36 Wildfire History 1993-2017



4.17.3 Location

Wildfires are commonly perceived as hazards in the western part of the state; however, wildfires are a growing problem in the wildland-urban interfaces of eastern Colorado, including communities within the planning area.

The Colorado Forest Atlas (formerly called CO-WRAP) is the primary mechanism for the Colorado State Forest Service to collect, analyze, and deploy risk information about wildfire issues across the state. Not only is the purpose to create awareness about wildfire risk, but it is also designed to provide baseline data needed to support mitigation activity and wildfire prevention in diverse communities across Colorado.

The Forest Atlas calculates a composite risk rating based on the possibility of loss or harm occurring from a wildfire. It identifies areas with the greatest potential impacts from a wildfire by considering multiple values and assets combined together – WUI risk, drinking water risk, forest assets risk, and riparian areas risk. This risk index has been calculated using the same variables and methods across the state to allow for comparison. The wildfire risk classes for the planning area are show in Figure 4-37.

The Forest Atlas also maps the Wildland Urban Interface (WUI) – which are generally the areas of greatest concern. The WUI is 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. The Colorado Forest Atlas defines the WUI using housing density data to delineate where people and structures meet and intermix with wildland fuels. While much of the planning area is built out, WUI areas do exist throughout the planning area as shown in Figure 4-38.

The wildland fire risk in the planning area is not particularly high compared to the mountain counties of Colorado. Areas identified as being at risk of wildfires make up 13.1% of improved parcels in the City of Thornton, 11.5% in the City of Federal Heights, and only 3.4% of the City of Northglenn. (See Section 4.17.7.) However, events such as the December 2021 Marshall Fire exhibit the damaging potential of grass fires in the plains and how quickly they can spread to urban areas.

Overall, the geographic extent of the planning area at risk of wildfires is **significant** for most of the planning area, and **limited** in Federal Heights.

Figure 4-37 Federal Heights, Northglenn, Thornton Wildfire Risk

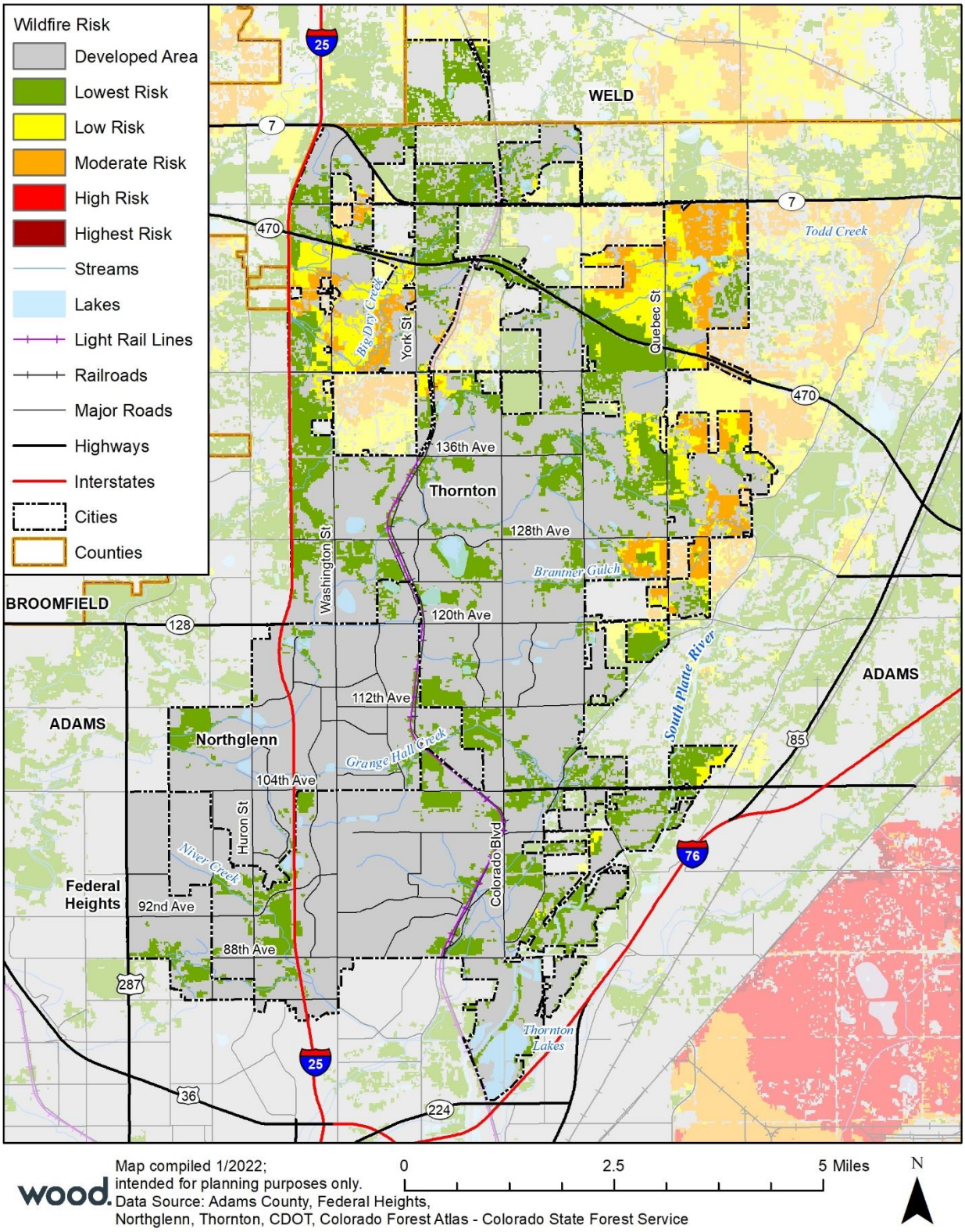
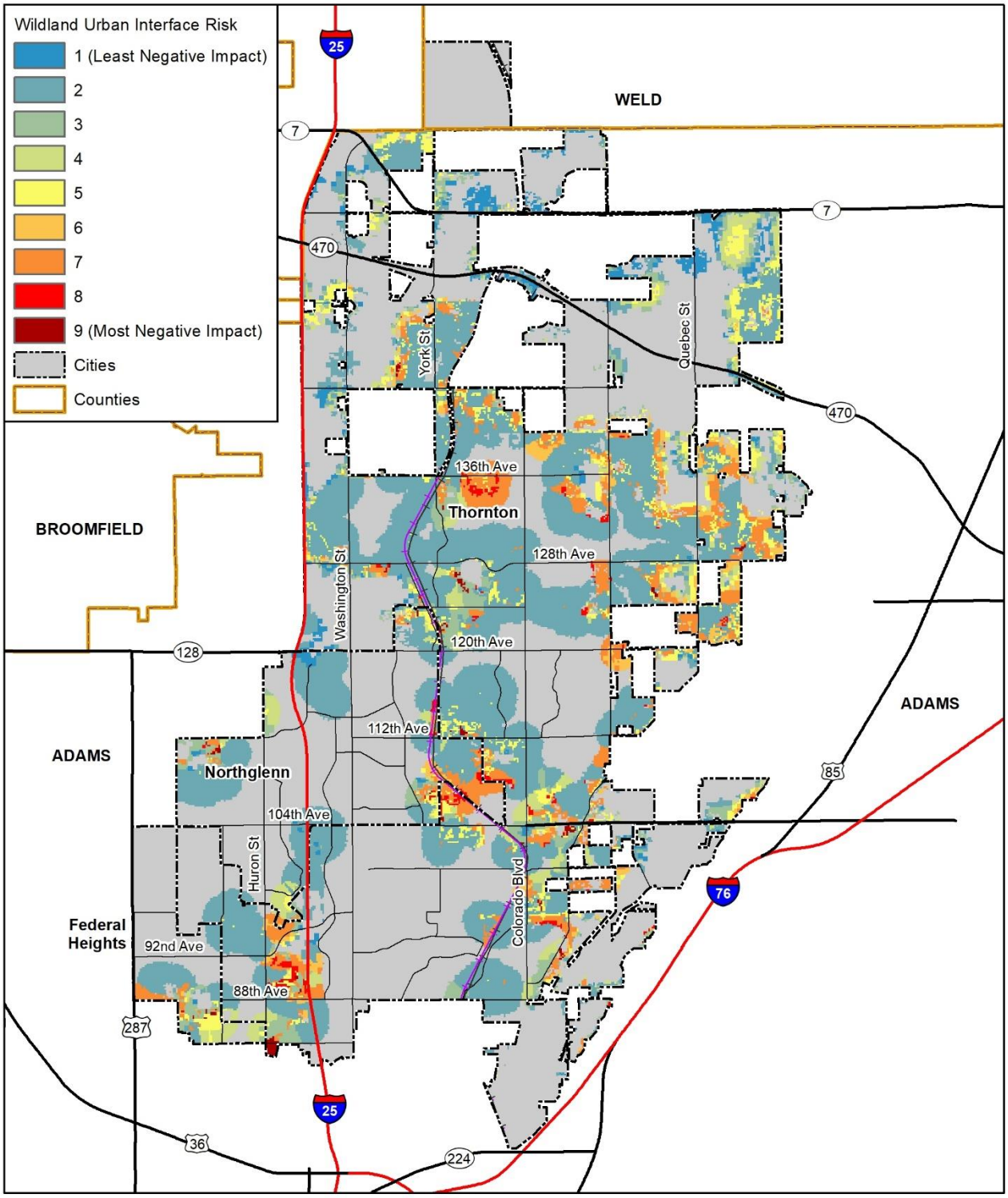


Figure 4-38 Federal Heights, Northglenn, Thornton WUI Risk



4.17.4 Magnitude/Severity

Local impacts from wildfire events are measured based on a variety of factors, including:

- Loss of life (human, livestock, wildlife)
- Damage to municipal watersheds
- Loss of property
- Evacuations
- Transportation interruption (closing highways)
- Reductions in air quality and human health
- Injuries – burns, smoke inhalation, etc.
- Coal seam or other energy facility ignitions
- Loss of vegetation (erosion, loss of forage and habitat for livestock and wildlife)
- Expense of responding (equipment, personnel, supplies, etc.)
- Loss of revenue from destroyed recreation and tourism areas

Predicting the intensity of a wildfire, its rate of spread, and its duration are important for wildfire mitigation activity, response, and firefighter safety. Three key factors affect wildfire behavior in the WUI:

1. **Fuels:** The type, density, and continuity of surrounding vegetation and, sometimes, flammable structures, which provide fuel to keep a wildfire burning. Fuels consist of combustible materials and vegetation (including grasses, leaves, ground litter, plants, shrubs, and trees) that feed a fire.
2. **Weather:** Relative humidity, wind, and temperatures all affect wildfire threat and behavior.
3. **Topography:** The steepness and aspect (direction) of slopes, as well as building-site locations, are features that affect fire behavior.

Very often the only factor that a community can have direct influence over is fuel.

The Colorado Forest Atlas provides a description of fire intensity potential based on the conditions within the planning area. The tool uses the Fire Intensity Scale (FIS), 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 represent very low wildfire intensities, and the maximum class (Class 5) represents very high wildfire intensities.

Descriptions of the FIS classes are listed below:

- **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 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.

The majority of the planning area is classified as low to moderate for fire intensity.

Given the lack of history of damages from wildfires in the planning area and low to moderate fire intensity, severity is estimated to be **moderate**, although the possibility for more damaging fires does exist.

4.17.5 Probability of Future Occurrences

Figure 4-36 above shows 689 wildfires fires occurring in the city limits of Federal Heights, Northglenn, and Thornton from 1993 through 2017. This equates to an average of 27 fires a year. However, the vast majority of those fires were less than an acre and had minimal impact. The probability of future damaging wildfires is **likely**.

Wildfires can occur at any time of day and during any month of the year. Moreover, the length of a wildfire season and/or peak months may vary appreciably from year to year. Recent wildfires and brush fires across Colorado have forced school closures, disrupted telephone services by burning fiber optic cables, damaged railroads and other infrastructure, and adversely affected tourism, outdoor recreation, and hunting. The likelihood of one of those fires attaining significant size and intensity within the planning area is highly unlikely. That said, weather conditions, particularly drought events, increase the likelihood of wildfires occurring.

4.17.6 Climate Change Considerations

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. Colorado and the WUS have 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.

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.

Land use, vegetation, available fuels, and weather conditions (including wind, low humidity, and lack of precipitation) are chief factors in determining the number and size of fires in Colorado each year. Generally, fires are more likely when vegetation is dry from a winter with little snow and/or a spring and summer with sparse rainfall. Conversely, an abnormally wet spring can increase the amount of available fuels, which then dry out in the summer. As a result, climate-induced hazards in Colorado (specifically, a pattern of extended drought conditions) have contributed to increased concern about wildland fire in Denver.

The frequency, intensity, and duration of wildland fires have increased across the WUS since the 1980s. The USDA's "Effects of Climate Variability and Change on Forest Ecosystems" General Technical Report, published in December 2012, found that the Colorado region, among others, will face an even greater fire risk over time. The report expects Colorado to experience up to a five-fold increase in acres burned by 2050. The report's findings are consistent with previous studies on the relationship between climate change and fire risk. Colorado landscapes, including those that characterize the planning area, are

expected to become hotter and drier as the planet warms, which in turn is expected to increase regional wildland fire risk.

4.17.7 Vulnerability Assessment

People

The greatest risk to people from direct wildland fires is to those in the City of Thornton or the northwestern and northeastern portions of the planning area. Much of the urbanized areas of the planning area have limited wildland fire risk, but there are still an estimated 21,236 residents living within the moderate, low, or lowest wildland fire risk areas as broken down in Table 4-52.

Table 4-52 Population Living in Areas of Wildfire Risk

Jurisdiction	Moderate Risk	Low Risk	Lowest Risk	Total At Risk
Federal Heights	0	**0**	**429**	429
Northglenn	44	26	774	844
Thornton (City)	2,544	2,245	10,591	15,380
Thornton Growth Area	1,477	1,647	1,459	4,583
TOTAL	**4,065**	**3,918**	**13,253**	**21,236**

Source: Colorado Forest Atlas, County Assessor's Data

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.

General 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.

Table 4-53 through Table 4-55 below provide estimated parcel/building counts and exposure values by property type for buildings located within the various wildland fire risk zones mapped for the planning area. Overall, areas identified as being at risk of wildfires make up 13.1% of improved parcels in the City of Thornton, 13.0% of Thornton's Growth Area, 11.5% in the City of Federal Heights, and only 3.4% of the City of Northglenn.

Table 4-53 Properties at Moderate Wildland Fire Risk

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Northglenn	Agricultural	20	33	$8,416,848	$8,416,848	$16,833,696
	Commercial	1	1	$274,367	$274,367	$548,734
	Residential	11	15	$3,898,933	$1,949,467	$5,848,400
	Total	**32**	**49**	**$12,590,148**	**$10,640,682**	**$23,230,830**
Thornton	Agricultural	1	2	$120,660	$120,660	$241,320
	Commercial	5	5	$607,972	$607,972	$1,215,944
	Exempt	2	2	$2,183,499	$2,183,499	$4,366,998
	Residential	830	851	$343,297,141	$171,648,571	$514,945,712
	Total	**838**	**860**	**$346,209,272**	**$174,560,702**	**$520,769,974**
Thornton Growth Area	Agricultural	3	7	$745,030	$745,030	$1,490,060
	Commercial	1	4	$188,521	$188,521	$377,042
	Exempt	1	1	$2,857	$2,857	$5,714
	Residential	299	494	$136,639,074	$68,319,537	$204,958,611
	Total	**304**	**506**	**$137,575,482**	**$69,255,945**	**$206,831,427**
Grand Total		**1,174**	**1,415**	**$496,374,902**	**$254,457,328**	**$750,832,230**

Source: Colorado Forest Atlas, County Assessor's Data

Table 4-54 Properties at Low Wildland Fire Risk

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Northglenn	Agricultural	17	24	$4,101,374	$4,101,374	$8,202,748
	Commercial	4	6	$2,257,530	$2,257,530	$4,515,060
	Exempt	2	4	$0	$0	$0
	Residential	7	9	$2,405,631	$1,202,816	$3,608,447
	Total	**30**	**43**	**$8,764,535**	**$7,561,720**	**$16,326,255**
Thornton	Agricultural	2	6	$347,317	$347,317	$694,634
	Commercial	10	10	$32,027,314	$32,027,314	$64,054,628
	Exempt	2	9	$661,741	$661,741	$1,323,482
	Residential	741	751	$347,837,402	$173,918,701	$521,756,103
	Total	**755**	**776**	**$380,873,774**	**$206,955,073**	**$587,828,847**
Thornton Growth Area	Agricultural	10	25	$4,413,789	$4,413,789	$8,827,578
	Commercial	1	1	$4,980	$4,980	$9,960
	Exempt	2	3	$2,409,227	$2,409,227	$4,818,454
	Residential	395	551	$202,971,685	$101,485,843	$304,457,528
	Total	**408**	**580**	**$209,799,681**	**$108,313,839**	**$318,113,520**
Grand Total		**1,193**	**1,399**	**$599,437,990**	**$322,830,631**	**$922,268,621**

Source: Colorado Forest Atlas, County Assessor's Data

Table 4-55 Properties at Lowest Wildland Fire Risk

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Federal Heights	Commercial	2	3	$2,382,354	$2,382,354	$4,764,708
	Exempt	7	10	$4,359,189	$4,359,189	$8,718,378
	Residential	142	145	$133,215,736	$66,607,868	$199,823,604
	Total	**151**	**158**	**$139,957,279**	**$73,349,411**	**$213,306,690**
Northglenn	Agricultural	10	24	$2,077,778	$2,077,778	$4,155,556

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
	Commercial	14	17	$31,049,419	$31,049,419	$62,098,838
	Exempt	9	11	$44,476,712	$44,476,712	$88,953,424
	Industrial	3	3	$8,926,788	$13,390,182	$22,316,970
	Residential	249	267	$349,909,473	$174,954,737	$524,864,210
	Total	**285**	**322**	**$436,440,170**	**$265,948,828**	**$702,388,998**
Thornton	Agricultural	9	19	$3,138,897	$3,138,897	$6,277,794
	Commercial	66	98	$173,980,925	$173,980,925	$347,961,850
	Exempt	43	65	$371,469,184	$371,469,184	$742,938,368
	Industrial	1	1	$9,469,711	$14,204,567	$23,674,278
	Mobile Home	4	38	$560,568	$280,284	$840,852
	Residential	3,470	3,504	$1,827,965,882	$913,982,941	$2,741,948,823
	Total	**3,593**	**3,725**	**$2,386,585,167**	**$1,477,056,798**	**$3,863,641,965**
Thornton Growth Area	Agricultural	30	86	$11,235,326	$11,235,326	$22,470,652
	Commercial	2	2	$45,985	$45,985	$91,970
	Exempt	11	30	$21,975,648	$21,975,648	$43,951,296
	Residential	341	488	$149,400,026	$74,700,013	$224,100,039
	Total	**384**	**606**	**$182,656,985**	**$107,956,972**	**$290,613,957**
Grand Total		**4,413**	**4,811**	**$3,145,639,601**	**$1,924,312,008**	**$5,069,951,609**

Source: Colorado Forest Atlas, County Assessor's Data

Critical Facilities and Infrastructure

According to analysis on data from Colorado Forest Atlas, 60 critical infrastructure facilities have been identified in areas with some level of fire intensity risk; all but three are located within the City of Thornton. Seven facilities are in areas of moderate risk, ten facilities are in areas of low risk, and 40 facilities are in lowest risk areas.

Table 4-56 Critical Facilities Exposed to Wildfire Risk

Jurisdiction	FEMA Lifeline	Critical Facility Type	Count
Moderate Wildfire Risk			
Thornton	Hazardous Material	Tier II Facility	4
	Transportation	Non-Scour Fair Condition Bridge	1
		Non-Scour Good Condition Bridge	1
		Non-Scour Poor Condition Bridge	1
		Total	**7**
Low Wildfire Risk			
Thornton	Communications	Communication Towers	1
		Microwave Towers	1
	Hazardous Material	Tier II Facility	4
	Safety and Security	Fire / Police Station	1
		School	1
	Transportation	Non-Scour Good Condition Bridge	2
		Total	**10**
Lowest Wildfire Risk			
Northglenn	Communications	Land Mobile Private Tower	2
	Safety and Security	Landfills/Govt. Services	1
		Total	**3**
Thornton	Communications	Communication Towers	1
		Land Mobile Private Tower	7
		Microwave Towers	2
	Energy	Electric Substations	1
	Food, Water, Shelter	Gravel Mines/Ponds	3
	Hazardous Material	Tier II Facility	7
	Health and Medical	Assisted Living	2
		Hospital	1
		Senior Housing	1
	Safety and Security	Community Center	2
		Daycare	1
		Landfills/Govt. Services	1
		School	5
	Transportation	Non-Scour Fair Condition Bridge	3
		Non-Scour Good Condition Bridge	3
		Total	**40**
		Grand Total	**60**

Source: Colorado Forest Atlas, County Assessor's Data, Federal Heights, Northglenn, Thornton

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 be centered in risk areas in Thornton. 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.

Historic, Cultural and Natural Resources

Fire is a keystone process in the natural environment, providing many benefiting impacts to the surrounding habitat. Some natural resources and natural areas may benefit from wildland fire, as at some level they must also be exposed to wildland fire for a healthy ecological development of the area. However, extremely hot fires can result in habitat loss, watershed damage and increased erosion, and other impacts that could take decades to recover.

Land Use and Development

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 Northglenn and Federal Heights are 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.

There are an estimated 4,586 people in the Thornton growth area within the lowest, low, or moderate wildland fire risk areas. Table 4-57 shows estimated exposure values by property type for buildings located within the various wildland fire risk zones mapped for the Thornton growth area.

Table 4-57 Wildfire Risk by Property type for Thornton Growth Area Properties

Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Moderate Wildfire Risk					
Agricultural	3	7	$745,030	$745,030	$1,490,060
Commercial	1	4	$188,521	$188,521	$377,042
Exempt	1	1	$2,857	$2,857	$5,714
Residential	299	494	$136,639,074	$68,319,537	$204,958,611
Total	**304**	**506**	**$137,575,482**	**$69,255,945**	**$206,831,427**
Low Wildfire Risk					
Agricultural	10	25	$4,413,789	$4,413,789	$8,827,578
Commercial	1	1	$4,980	$4,980	$9,960
Exempt	2	3	$2,409,227	$2,409,227	$4,818,454
Residential	395	551	$202,971,685	$101,485,843	$304,457,528
Total	**408**	**580**	**$209,799,681**	**$108,313,839**	**$318,113,520**
Lowest Wildfire Risk					
Agricultural	30	86	$11,235,326	$11,235,326	$22,470,652
Commercial	2	2	$45,985	$45,985	$91,970
Exempt	11	30	$21,975,648	$21,975,648	$43,951,296
Residential	341	488	$149,400,026	$74,700,013	$224,100,039
Total	**384**	**606**	**$182,656,985**	**$107,956,972**	**$290,613,957**
Grand Total	**1,096**	**1,692**	**$530,032,148**	**$285,526,756**	**$815,558,904**

Source: Colorado Forest Atlas, County Assessor's Data

There are 49 critical facilities have been identified in areas with some level of fire intensity risk within the Thornton Growth area.

Table 4-58 Critical Facilities at Risk to Wildfire Within the Thornton Growth Area

FEMA Lifeline	Critical Facility Type	Count
Moderate Wildfire Risk		
Communications	Communication Towers	2
Hazardous Material	Tier II Facility	4
Safety and Security	School	1
Transportation	Non-Scour Good Condition Bridge	2
	Total	**9**
Low Wildfire Risk		
Communications	Communication Towers	1
	Land Mobile Private Tower	1
Energy	Electric Substations	1
Food, Water, Shelter	Gravel Mines/Ponds	1
Hazardous Material	Tier II Facility	12
Transportation	Non-Scour Fair Condition Bridge	1
	Total	**17**
Lowest Wildfire Risk		
Communications	Communication Towers	2
	Land Mobile Private Tower	5
	Microwave Towers	2
Energy	Power Plant	1
Food, Water, Shelter	Gravel Mines/Ponds	3
Hazardous Material	Tier II Facility	5
Safety and Security	Landfills/Govt. Services	3
Transportation	Non-Scour Fair Condition Bridge	2
	Total	**23**
	Grand Total	**49**

Source: Colorado Forest Atlas, County Assessor's Data, Federal Heights, Northglenn, Thornton

4.17.8 Jurisdictional Differences

The wildfire threat in the planning area is highest in northern Thornton, which has several areas of low to moderate risk. Northglenn and Federal Heights both have some areas at lowest risk.

In the 2017 HMP, wildland fire rated as medium significance for the City of Northglenn, and low significance for the Cities of Thornton and Federal Heights. For the 2023 update, a closer analysis of the actual impacts of recent wildland fires led the City of Thornton to rank it as medium significance.

4.17.9 Risk Summary

- Overall wildfire risk in the planning area is **medium** to **low**.
- Areas at risk of wildfires make up 13.1% of Thornton, 11.5% of Federal Heights, and 3.4% of Northglenn.
- 21,236 residents live in areas with some wildfire fire risk.
- Widespread smoke from wildfires outside of the planning area is an indirect impact of wildfire.
- 60 critical facilities are at some level of fire risk, all but three are located within Thornton.
- Related hazards: Drought, Excessive Heat, Severe Warm-Weather Storms, Public Health, Ground and Surface Water Supply Contamination, Hazardous Materials, Mass Transportation Incident.

5 Mitigation Strategy

DMA 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 shall include: (i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards. (ii) 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. (iii) 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 costs.

Hazard Mitigation Plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). In support of the guiding principle established in Section 1.2.1, the HMPC developed a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, and mitigation actions in this plan all support each other. Goals were selected to support the guiding principle. Mitigation actions were prioritized based on the action meeting multiple objectives and priority hazards.

5.1 Mitigation Goals

Goals are defined for the purpose of this 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; and
- 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 mitigation actions that will be used as means to achieve the goals.

Objectives are an optional level between goals and mitigation actions that help define strategies to attain the goals and are more specific and measurable. The 2017 HMP did not include any objectives, and the HMPC felt there was no need to add objectives for the 2023 update.

To facilitate the goals section of this plan update, HMPC members were provided a breakdown of the list of goals from the 2017 Thornton, Federal Heights, and Northglenn Natural Hazard Mitigation Plan, along with goals and objectives from several related plans, including the 2018 State of Colorado Hazard Mitigation Plan. This review was conducted to ensure the plan's mitigation strategy reflected current policies and priorities, updated risk assessment information, and was integrated with existing plans and policies. They were told that they could use, combine, or revise the statements provided or develop new ones, keeping the risk assessment in mind. Federal Heights and Northglenn felt the 2017 goals were still valid and did not make changes; Thornton reworded several of their 2017 goals to better reflect current priorities.

The following are the three cities' mitigation goals for this plan:

Thornton:

- Goal 1: Protect and enhance the resiliency of people, property, critical systems, and natural resources.
- Goal 2: Improve Thornton's ability to prevent and reduce physical, economic, and societal losses from disasters
- Goal 3: Enhance Thornton's ability to recover quickly and completely from future disaster incidents
- Goal 4: Ensure that functionality of local critical facilities and systems are maintained in the event of a disaster
- Goal 5: Strengthen communication and coordination among public agencies, NGOs, businesses, and residents to better prepare for, respond to, and recover from disaster situations
- Goal 6: Increase public awareness of hazard risks, vulnerabilities, and mitigation measures & resources
- Goal 7: Integrate hazard mitigation into planning documents, budgeting processes, and other mechanisms

Federal Heights:

- Goal 1: Improve capability to reduce disaster losses
- Goal 2: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 3: Increase public awareness of natural hazards and mitigation options
- Goal 4: Integrate hazard mitigation into other planning mechanisms
- Goal 5: Increase the city's resilience to hazards during all phases of the Emergency Management Cycle
- Goal 6: Increase individual resilience to hazards

Northglenn:

- Goal 1: Protect people, property, and natural resources
- Goal 2: Improve capability to reduce disaster losses
- Goal 3: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 4: Increase public awareness of natural hazards and mitigation options

5.2 Progress on Mitigation Actions Since 2017

The Cities of Thornton, Federal Heights, and Northglenn have been successful in implementing actions identified in the 2017 Plan. The 2017 mitigation strategy contained a total of 120 mitigation actions, 42 of which were identified as having been completed. An additional 9 actions were deleted as being no longer relevant. These completed and deleted actions are shown in Table 5-1.

Table 5-1 2017 Mitigation Actions Completed or Deleted

2017 ID #	Mitigation Action Title	Hazard	Notes
FH2	**Hazardous Tree Mitigation.**	High Winds/ Tornado	**Completed.** Ongoing efforts are being made to review all new building projects for 2018 building codes. City infrastructure including utilities undergrounding and open space improvement continue to be priorities for city funded projects.
FH6	**Ruston Park Detention.** Increase the volume of the existing detention pond in Ruston Park to 6.7 acre-feet to reduce peak flows downstream. Provide a 54" pipe outlet to convey discharges from the pond to the channel on the east side of Zuni Street.	Flooding	**Completed.** In 2021 the city of Federal heights began implementation of a major upgrade to Ruston Park including increasing the volume of the existing Detention Pond.
FH7	**Water Quality.** The city of Federal Heights actively regulates all flood related building, development, and improvement procedures using a formal building and improvement process that involves review by a planning and review department, building and engineering professionals as well as city administrators. The city also has adopted multiple flood control and improvement guidelines outlined in Chapter 34 articles I-V of the City of federal Heights adopted municipal code.	Flooding	**Completed.** As part of the drainage utility program the city contracts street sweeping operations 6 times each year and conducts storm drain/inlet clean out after each major storm event. Along with the external drain mitigation efforts the city public works department also operates a 3-year rotating plan for cleaning out and maintaining the cities internal flood drain traps/boxes.
NG1	**Drought Communication Outreach.** Update current community outreach public information regarding water conservation measures for defined drought conditions	Drought	**Completed.** Webpage: https://www.northglenn.org/residents/water/water_-_drought_watch.php
NG2	**Fire Code Updates.** Once every six (6) years, adopt the latest edition of the International Fire Code, related codes, and appropriate local amendments.	Wildland Fire, Lightning	**Completed.** Updated to the 2018 in 2020
NG4	**Winter Storm Communication Outreach.** The city current employs an extensive outreach program focused on notification of server weather events, snow routes, and winter weatherization efforts on an annual basis. This is accomplished through newsletters, mailers, social media, and municipal cable access channel	Winter Storm	**Completed.** Current comms plan (internal and external) for actual inclement weather comms is attached separately. Again, we also do regular public comms on how to handle/what to expect in extreme weather.
NG5	**Building Code Updates.** Update International Building Codes to the most recent edition of the International Building Code and related documents and make appropriate local amendments.	Flood, Severe Storms, Tornado/Severe Wind, Earthquake, Extreme Temperatures, Expansive Soils/ Undermined Areas, and Winter Storms.	**Completed.** Updated to the 2018 in 2020 - looking to update to 2021 with strengthening amendments in Q3 or Q4 this year. - plan to start updating with every code cycle.
TH3	**128th Avenue & Brantner Gulch.** Replace culvert with bridge to handle 100-year flows and eliminate overtopping.	Flood	**Completed.**
TH 4	**144th Ave at Big Dry Creek.** Raise roadway and reconstruct culverts/new bridge to get arterial street out of the floodplain.	Flood	**Completed.**
TH6	**Adopt an Emergency Operations Plan.** A city Emergency Operations Plan will be a resource for staff/volunteers to reference in the case of a hazard event. It will outline protocol and staff roles. An addition to go along with this would include	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas,	**Completed.** EOP approved in 2019, annual reviews with track changes. Full update 2024.

2017 ID #	Mitigation Action Title	Hazard	Notes
	training city staff to be educated about what to do in emergencies. Should cover all city departments.	Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	
TH13	**Building Code Updates.** Update Thornton's building codes to the most recent edition of the International Building Code and related documents and make appropriate local amendments.	Flood, Severe Storms, Tornado/Severe Wind, Earthquake, Extreme Temperatures, Expansive Soils/Undermined Areas, and Winter Storms.	**Completed**. Thornton updates its building codes every three years. The 2021 codes are scheduled for adoption during the last half of 2022.
TH16	**West Cooley Reservoir Complex Spillway.** Design and construction of three spillways.	Flood, Severe Storms	**Completed.** All Spillway construction and post inspections have been completed.
TH23	**Create an Emergency Response Unit.** Provide personnel, appropriate protective clothing, vehicles, and road barricades.	Flood, Tornado/ Severe Wind, Wildland Fire	**Completed**. Employee Emergency Response Teams have been developed at each city facility to help assist employees during emergencies and disasters that impact city buildings. Department roles and responsibilities for public safety and supporting incident response have been defined in the EOP and reinforced through daily operations, training, and exercise. Thornton CERT is an emergency support unit to assist public safety capacity during a disaster.
TH26	**Emergency Management Staffing.** The project would include the reclassification of the current position title and responsibilities to focus solely on emergency management programs, allocating funds and working space for a part-time position to support emergency management efforts, along with an internship position for additional project work.	All-hazards	**Completed**. Emergency Management full-time positions acquired in 2018 and Safety Administrator hired in 2019 to take on all non-EM related duties. Partnership established with University of Colorado Denver for internship opportunities and capstone students.
TH27	**Emergency Operations Center (EOC) Training.** Implement an EOC training for city staff. This would include tabletop exercises and could be for the entire city staff. UASE puts on trainings for this and would cost approximately $10k.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	**Completed**. EOC Training and Exercise Plan instituted in 2019-early 2020. On-hold due to COVID19, reevaluated/reinitiated in 2022.
TH28	**Formulate IGA's with Schools for Inoculation Sites.** Then work with the IGA to put on trainings and events where community members can be vaccinated, preventively or during times of public health emergencies, and informed about public health hazards.	Public Health Hazards	**Completed.** Due to the COVID-19 Pandemic, these operations became a real time POD exercise and will be evaluated throughout operations for improvements and efficiency upgrades.

2017 ID #	Mitigation Action Title	Hazard	Notes
TH40	**Repetitive loss structure identification.** Work to identify repetitive loss structure and formulate plans for how best to mitigate, in conjunction with the property owner.	Flood	**Completed.**
TH44	**Hazard Mitigation in Comprehensive Planning and Other City Plans.** The project would involve the project managers and consultants (if any) working on all City of Thornton plans to be aware of the goals and action guides of the Local Hazard Mitigation Plan and to actively work toward the integration of appropriate elements of that plan into the plan that they are writing or updating.	All-hazards	**Completed**. The 2020 Thornton Comprehensive Plan was adopted in July of 2020 and is supportive of Hazard Mitigation Planning and plan implementation. As future updates are made to this and other long-range plans, hazard mitigation will also be supported within them.
TH48	**Incorporate resiliency measures in Utility Master Plan.** Include hazard mitigation measures or even a chapter/section relating to hazard mitigation/ resiliency into the upcoming Utility Master Plan update.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	**Completed**.
TH49	**Increase fuel, salt, and sand storage for winter storms.** Identify options for increasing storage of fuel, salt, and sand across the city.	Winter Storm	**Completed**.
TH50	**Increase Staffing for EM Projects.** Hire additional EM staff personnel to tackle projects relating to hazard mitigation. Identify needs and areas to improve upon (many of these MAGs are great ideas to try and implement) and assign staff to address these needs.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	**Completed**. Full-time EM position was added in 2018 and full duties and responsibility shifted in 2019.
TH52	**Lakeview Estates Drainage Corrections.** Neighborhood south of SH 7 along Ulster Street with inadequate stormwater conveyance. Water spills into east side properties and into several homes. Stormwater system needs re-evaluated and upgraded.	Flood	**Completed**.
TH56	**Public Warning/ Notification Project.** The project is a priority for 2017 to switch over to a more up-to-date notification system and improve our reach to the community.	All-hazards	**Completed**. CodeRED contract was signed in 2017; All City Employee Enrollment in 2018; IPAWS Alerting Authority in 2019; and Alert and Warning Plan development, update marketing, and training/exercise plan in 2022.
TH59	**Public Education on Snow Removal.** Create a public awareness campaign to educate citizens about not shoveling snow into the streets. Educating them about the hazards and what are the correct ways to shovel snow.	Winter Storm	**Completed**.
TH62	**Remote Work Capability.** The project would include the essential functions/ personnel identified in the City Continuity of Operations Plan/ Continuity of Government Plan, to provide them with laptops or home computer stations to work from home, expanding the capacity of our online Citrix platform to support all essential functions at one time, a change in city philosophy/ employee policy that allows for the city close or announce delays during winter storms or other emergency events, and providing alternate communications methods for employees to hold meetings/ teleconferences from different remote locations.	All-hazards	**Completed**. The Pandemic led to the development of a Remote Work Policy and deployment of hardware to key personnel.

2017 ID #	Mitigation Action Title	Hazard	Notes
TH65	**Reservoir Spillway Project.** The project would ideally be a long-term project to incrementally improve each of our reservoirs to prevent damage.	Flood	**Completed**.
TH66	**River/Stream Gauge Project.** The project would be the purchase of additional river or stream gauges to be placed in areas that provide data to our city Floodplain Manager	Flood	**Completed**.
TH68	**Incorporate Age-Restricted Communities, Nursing Homes, and other Senior Care Centers into Planning Processes.** Engaging senior residence and treatment facilities in future planning processes would enhance the community's ability to provide appropriate warnings to these populations of upcoming inclement weather and other natural hazard phenomena, help increase the level of understanding of how emergency services can and should be provided to seniors who are affected by hazardous events and coordinating the relocation of these populations should that become necessary.	All-hazards	**Completed**. In the process of developing the 2020 Thornton Comprehensive Plan, Thornton staff conducted outreach to many of the senior living facilities located within Thornton, and was careful to arrange public meetings at locations that were accessible to people with mobility challenges. The City also completed a Boomer Bond Assessment in March of 2020. This document provides and extensive review of how the Thornton community addresses the needs of seniors, and what improvements they should consider making in the future.
TH78	**Villages North Detention Basin Emergency Overflow Structure. (Basin 4100)** Detention basin south of Thornton Parkway, west of the tracks has a modeled 100-year pond and outlet structure. However, if the outlet structure were to become clogged, there is no overflow out of the basin before water would rise to the point that it floods structures west and north (proposed) of the basin.	Flood	**Completed**.
TH79	**Volunteer Emergency Response Units.** Create a group for volunteers that could be called upon for emergency response. This could be an expansion of the Citizens Police Academy Unit – there are several trained members of this group that could volunteer. Existing programs that could be referenced include one in Longmont and the Boulder Emergency Squad (BES). A part of this would include purchasing more radio units to create efficient communication.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	**Completed**. Thornton CERT Team meets this strategic action guide intent.
TH81	**Water Conservation Plan Update and Implementation.** Update Water Conservation Plan in 2017. Implement conservation programs as identified in the plan, including but not limited to promoting xeriscaping, water conservation programs, and public outreach efforts.	Drought	**Completed**. Water demand reduction efforts continue to be made within the context of Thornton's development review processes.
TH82	**West Sprat Platte Reservoir Spillway.** Design and construction of three spillways.	Flood, Severe Storms	**Completed**.
AdCo 4	**Dispatch Coordination.** Integrate NetCAD capabilities into Emergency Operations Center (EOC) operations for incident dispatch and coordination between dispatching agencies. Adams County has five different dispatching agencies that operate off the CAD system. Emergency managers operate off the WebEOC. These systems need coordination to better manage situational information and resource ordering between jurisdictions within the County.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	**Completed**. Received authorization to include CAD in the EOC and working with AdCom to implement. NCR is also working on Regional Coordination Framework and Resource Management Framework.

2017 ID #	Mitigation Action Title	Hazard	Notes
AdCo 6	**Ensure Uninterrupted Communications between County Departments During Emergencies.** Determine which County facilities currently have radios, assess the appropriateness and feasibility of hardwiring, and investigate other options to ensure constant and uninterrupted communications is maintained during critical events. Address the internal department communications to integrate Public Works, Assessors, and First Responders.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	**Completed**. County uses ReGroup for internal notifications through email, text, phone. Radios are available in OEM and EOC for contact with 1st Responders.
AdCo 9	**Hoffman Drainage Way Improvements.** Enlarge undersized creek watercourse to remove the more than 20 structures form the 100-year floodplain.	Flooding	**Completed**.
AdCo 10	**Little Dry Creek Flood Mitigation.** Since the Little Dry Creek is close to residential areas that are within the floodplain, property improvements include reconstruction and elevation of 68th Avenue and creating a park that will incorporate a regional detention pond which will help mitigate potential flooding of existing residences and provide recreational opportunities for Adams County citizens.	Flood	**Completed**.
AdCo 11	**Municipal Intergovernmental Agreements (IGAs) for Preparedness Partnerships.** Develop formal agreements. The development of a countywide IGA to integrate preparedness actions and response costs were not otherwise provided in state mutual aid agreements. Such IGA would provide for staffing of EOC recourses, damage assessment teams, public works trucks, and other equipment and labor pools.	Thunderstorms, Tornados, Flooding, Earthquakes, Severe Winter Storms, Earthquakes, Wildland Fire.	**Completed**. Completed revisions to the Cooperative Wildland Fire Agreement with BoCC approval in 2020, 2021, 2022. MOU completed with Denver UASI.
AdCo 13	**Redundant Emergency Operations Center (EOC) Communication System.** Investigate the implementation of a redundant communication system in the Adams County EOC and the County Government Center where the EOC is located. The telephone system currently used is VOIP. Cell phone coverage is limited or non-existent in some areas and land lines into the government center do not currently exist. While ARES capabilities are present in the EOC, they are not sufficient to manage the volume that may be necessary to support a Type I or Type II incident.	Thunderstorms, Tornados, Flooding, Earthquakes, Severe Storms, Wildland Fire.	**Completed**. 2021 we completed a $250,000 upgrade to the A/V systems in the EOC to include communications capabilities. The EOC includes landlines at each workstation, internal radio systems, 800 mghz radios, UHF/VHF, and ability to accommodate ARES. A Type I or II incident can be expanded into existing conference rooms located in the Government Center if needed.
AdCo 14	**Regional Park Access.** Develop, at minimum, at least one alternative point of ingress and egress to the Regional Park to ensure safe movement of personnel, visitors, and vehicles during an emergency event. Provide additional access to the Adams County Regional Park to improve emergency access.	Thunderstorms, Tornados, Flooding, Earthquakes, Severe Storms, Wildland Fire.	**Completed**. A second ingress/egress point into the Regional Park is in place near the heritage museum located on 124th Ave. This access point is commonly used during the Adams County Fair and July 4th events.
AdCo 17	**Storm Water and Flood Control Master Planning.** Adequate drainage control is necessary to protect neighborhoods throughout the County.	Flooding	**Completed**. Implementation of projects identified in the County's Drainage Master Plan has resulted in 38 structures removed from the floodplain.
Xcel 1	**Thornton Substation.** Submit application for new substation if location is not zoned appropriately or if new parcel needs to be created.	Power Outage	**Completed.** New substation completed in 2021.
TH9	**Appoint a Structural Engineer Representative for Building Department.** Hire or contract out a structural engineer to represent the city that could evaluate properties for mitigation details. Building inspectors typically have one area of	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas,	**Canceled.**

2017 ID #	Mitigation Action Title	Hazard	Notes
	expertise, but it would be good to have someone who is cross-trained and can identify structures that need overall improvement to mitigate hazards. An addition to this would be to cross-train all building inspectors to check for a broad range of structural issues.	Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	
TH12	**Build Relationships with AIA and SEAC.** Building relationships with the American Institute of Architects (AIA) and the Structural Engineers Association of Colorado (SEAC) to increase the city's awareness of technical structural knowledge and to increase mitigation for local hazards to protect infrastructure.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	**Canceled.**
TH14	**Loss Prevention Project.** The project would require significant analysis of building techniques and approval from City Government and city Council for such regulatory provisions.	All-hazards	**Canceled**.
TH39	**Flood Action Plan for Wes Brown Water Treatment Plant.** Develop flood action plan for Wes Brown Water Treatment Plant. Review annually with local neighbors and businesses. Work to improved neighborhood communications and relations. Possibly develop a local association of commercial and residential interests that can respond collaboratively in an emergency.	Flood	**Canceled**.
TH46	**Urban Drainage Master Plan Updates.** Review master plans to identify flood hazards and mitigation measures to implement.	Flood	**Canceled**. Combined with other action
TH54	**Loss Prevention Project – Building Resiliency.** The project would require significant analysis of building techniques and approval from City Government and city Council for such regulatory provisions.	All-hazards	**Canceled**.
TH75	**Tornado Sirens.** The project would include the installing, maintenance, training, and public education that is necessary to implement the routine use of tornado sirens.	Tornados and Severe Storms	**Canceled**. Emergency Manager presentation to City Council 7/16/19, evaluating the effectiveness and costs of tornado sirens. Policy decision was the city would not pursue sirens for lack of ROI, technological concerns, and current capability of CodeRED and IPAWS for more efficient messaging to residents.
AdCo 5	**Early Warning Systems.** Investigate warning systems for unincorporated Adams County. Examine First Call, Notify Me, and others which would provide effective notification to citizens and businesses.	Thunderstorms, Tornados, Flooding, Wildland Fire	**Canceled**. Determined to be not feasible. Warning systems are administered by AdCom911. No systems administered by Adams County.
A12 1	**Emergency Food Provider.** Identify the costs and impact of interruption of services to the students for an extended timeline. Investigate all options to support the school district during a "disaster". Draw up an emergency plan with "trigger" points to help guide action.	Public Health Hazards Low level famine	**Canceled**.

In addition to the 42 completed actions, considerable progress has been made on other actions. Of the 71 actions carried over into the 2023 Plan, 38 were reported as being in progress or are already being implemented on an annual basis. Some of the challenges of implementation of projects included:

- Lack of funding, including ability to provide matching funds.
- Difficulty passing benefit cost analysis required for certain FEMA grants.
- Conflicting priorities, and intervention of major hazard events

5.2.1 Continued Compliance with NFIP

Recognizing the importance of the National Flood Insurance Program (NFIP) in mitigating flood losses, an emphasis will be placed on continued compliance with the NFIP for the cities in the planning area. As an NFIP participant, Thornton, Federal Heights, and Northglenn have 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 and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance. Thornton will also continue to participate in the Community Rating System (CRS) to go above and beyond the minimum requirements of the NFIP.

5.3 Identification and Prioritization of Mitigation Actions

To identify and select mitigation measures to support the mitigation goals, each hazard identified in Section 4.1: Identifying Hazards was evaluated regarding the various options for mitigation. Hazards that pose a significant threat to the community were considered the priority in the development of hazard specific mitigation measures.

The HMPC considered the following categories of mitigation actions, as defined in FEMA's 2013 Local Mitigation Planning Handbook:

- **Plans and regulations:** These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
- **Structure and infrastructure projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- **Natural systems protection:** These are actions that minimize damage and losses and preserve or restore the functions of natural systems.
- **Education and awareness:** These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them.

The HMPC also considered the following categories as defined in the Community Rating System:

- **Prevention:** Administrative or regulatory actions or processes that influence the way land and buildings are developed and built.
- **Property protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area.
- **Structural:** Actions that involve the construction of structures to reduce the impact of a hazard.
- **Natural resource protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems.
- **Emergency services:** Actions that protect people and property during and immediately after a disaster or hazard event.
- **Public information/education and awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.

At planning meeting #3, the HMPC was provided with handouts describing the categories and listing examples of potential mitigation actions for each category, as well as for the identified hazards. FEMA's 2013 document *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* was referenced and made available for reference, along with FEMA's 2020 Mitigation Action Portfolio. Attendees were then asked to submit mitigation action ideas via an online poll. Action submissions included details describing how the actions will be implemented and administered, to include cost estimates, potential funding sources, and estimated timeline for completion. Each action was required to be tied to one or more of that city's goals.

Actions were compared against identified hazards to ensure that the plan contains a comprehensive range of mitigation actions and projects for each of the highest risk hazards. An emphasis on both new and existing buildings and infrastructure was stressed. While the HMPC focused primarily on those hazards identified as posing the highest risk to the jurisdiction, mitigation actions were also suggested for some low priority hazards.

Similarly, while the primary focus was on developing mitigation actions in the categories described above, some actions were proposed that do not fall into one of the above categories and which may be better defined as planning or preparedness actions. Some of these actions were nonetheless included in the plan, as the jurisdiction felt they were important actions to reduce losses from future disasters even if they do not meet the strict definition of mitigation.

In all a total of 31 new mitigation actions were identified, as summarized in Table 5-2.

5.3.1 Prioritization Process

Once the new mitigation actions were identified, the HMPC members were provided with several sets of decision-making tools, including FEMA's recommended STAPLEE criteria:

- **Social:** Does the measure treat people fairly?
- **Technical:** Will it work? (Does it solve the problem? Is it feasible?)
- **Administrative:** Is there capacity to implement and manage the project?
- **Political:** Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support the project?
- **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? Does it reduce direct property losses or indirect economic losses?
- **Environmental:** Does it comply with environmental regulations or have adverse environmental impacts?

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining project priority – the economic factor of STAPLE/E. Other criteria used to recommend what actions might be more important, more effective, or more likely to be implemented than another included:

- Does the action protect lives?
- Does the action address hazards or areas with the highest risk?
- Does the action protect critical facilities, infrastructure, or community assets?
- Does the action meet multiple goals or multiple hazards?

The above criteria were used to prioritize actions in an iterative process over the course of the plan update process. At the start of the process, participants were asked to validate or update the priorities of their continuing actions from the 2017 Plan. When submitting new mitigation actions, HMPC members

were asked to prioritize those as well. Finally, once all new and continuing actions had been collated into a draft mitigation strategy, participants were asked to verify or update the priorities of each action.

5.4 2023 Mitigation Action Plan

This section outlines the development of the final updated mitigation action plan. The action plan consists of the 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.

As noted above, 120 mitigation actions were included in the 2017 Plan. Of those, 42 were reported as having been completed and 9 were determined to be no longer relevant and were deleted. (See Table 5-1.) The remaining 69 actions were carried over into the 2023 Plan, along with 35 new actions.

Table 5-2 2023 Mitigation Action Plan Summary

Jurisdiction	Actions in 2017 HMP	Actions Completed	Actions Canceled	Actions Continued	New Actions Added	Actions in 2023 HMP
City of Federal Heights	9	3	0	6	7	13
City of Northglenn	8	5	0	3	7	10
City of Thornton	82	25	7	50	19	69
Adams County	16	8	1	7	0	7
Adams 12 Five Star Schools	1	0	1	0	0	0
School District 27J	1	0	0	1	0	1
Tri-County Health Dept	1	0	0	1	0	1
United Power & Tri-State	1	0	0	1	1	2
Xcel Energy	1	1	0	0	0	0
RTD	0	0	0	0	1	1
Total	**120**	**42**	**9**	**69**	**35**	**104**

The 2023 Thornton, Federal Heights, Northglenn mitigation action plan lists the actions developed and prioritized as described above, to include continuing actions from the 2017 Plan. The action plan details how the Cities will reduce the vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. The action plan summarizes who is responsible for implementing each of the prioritized actions as well as when and how the actions will be implemented. All actions are tied to specific goals and objectives to ensure alignment with the Plan's overall mitigation strategy. Additionally, projects were tied to specific infrastructure Lifeline categories, to better align with the latest FEMA guidance and grant requirements. Over time the implementation of these projects will be tracked as a measure of demonstrated progress on meeting the plan's goals.

Many of these mitigation actions are intended to reduce impacts to existing development. In addition, actions are identified to reduce impacts to future development. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations. Actions that protect critical infrastructure note which lifeline category is protected using the following abbreviations:

- COM: Communications
- ENG: Energy
- FWS: Food, Water, Sheltering
- HAZ: Hazardous Waste
- H&M: Health & Medical
- S&S: Safety & Security
- TRN: Transportation

The mitigation action plans for each city can be found in their City Annex. Mitigation actions led by various partner agencies, to include Adams County (AdCo), are listed below. The Adams County actions listed are those from the 2020 Adams County Hazard Mitigation Plan and are included here for reference. They include information on the mitigation actions, lead and supporting agencies, estimated cost, potential funding sources, and estimated timeline.

Partner agencies are abbreviated as follows:

- AdCo: Adams County
- A12: Adams 12 Five Star Schools
- 27J: School District 27J
- TCHD: Tri-County Health Dept
- UP: United Power & Tri-State
- Xcel: Xcel Energy
- RTD: Regional Transportation District

The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

The estimated cost ranges were as follows:

- Low = less than $10,000
- Medium = more than $10,000 and less than $100,000
- High = more than $100,000

The status of actions carried over from the 2017 Plan were reported as follows:

- Not Started – Work has not begun
- In Progress – Work has begun but not completed
- Annual Implementation – Ongoing with no specific end date

Table 5-3 2023 Partner Agencies Mitigation Action Plan

#	Title and Description	Hazards Mitigated	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
Ad Co 1	**Regional Park Sheltering.** Review funding options as well as storm shelter alternatives (retrofitting or new construction) to provide Safe Rooms at the Adams County Regional Park. Provide adequate sheltering for severe storms and tornados. Currently, the park does not have adequate structures or facilities to shelter citizens during a significant weather event requiring immediate sheltering for life safety.	Thunderstorms, Tornados, Flooding	Adams County Parks;	TBD; General Fund, Grants	2023-2028	High	**Not Started;** There is work being done at the Regional Fairgrounds to replace a few buildings, however they are not specifically designated as shelters.
Ad Co 2	**Communications Plan for Critical Facilities within Adams County.** Investigate the options and develop a communication plan for critical facilities with input and assistance from County personnel including, but not limited to, County Emergency Management, Emergency Medical Services (EMS), Tri-County Health Department, care facilities, hospitals, Adams County schools, and others. Investigate and develop a communications plan with the at-risk population facilities. More specifically, facilities with large numbers of residents currently are not effectively connected to receive notification, warning, and information from the County Emergency Operations Center (EOC). In order to provide proper situational information and resources for public health needs, a communication plan any system are required. Investigate improved emergency communications systems with Adams County schools. County schools own their own communication systems to connect internally within their district. School districts within Adams County sit within multiple different municipal jurisdictions and are not effectively connected to receive notification, warning, and information from the County EOC. In order to provide proper situation information and resources to the schools and the communities they serve, a communication plan and system are required. Emergency Medical Services (EMS) lead is needed for proper Public Health/Hospital Coordination. EMS agencies are a part of the Public Health Plan, but due to statutory provisions, there is no lead EMS agency at the state or local level. While legislation is needed to rectify on a state scale, Adams County requires a communication plan to effectively coordinate EMS agencies during any event where multiple EMS agencies are involved.	Thunderstorms, Tornados, Flooding, Earthquakes, Severe Winter Storms, Earthquakes, Wildland Fire.	Adams County OEM and the Adams County Information Technology Department; Tri-County Health Department	TBD; Adams County General Fund, Tri-County Health Department, Grants	2023-2028	High	**In Progress;** Our emergency alerts and notifications are being updated working with AdCom-911 for the CodeRed system and we will be pushing out a CodeRed campaign the 2nd Q and through the remainder of the year. We do participate in quarterly communications exercises with the health department. The NCR is working on regional plans for patient coordination and tracking.

#	Title and Description	Hazards Mitigated	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
Ad Co 3	**Develop Recovery Plan Integrate Emergency Plan and Comprehensive Plan.** Assess the update cycle of the County Emergency Operations Plan and associated annexes as they support the County Comprehensive Plan. Determine activities to ensure that all plans are current and coordinated with the hazard mitigation and hazard identification and risk assessment process and the Comprehensive Plan.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	Adams County OEM; None	TBD; Adams County general fund and Emergency Management grants.	2022-2028	Low	**In Progress;** Revision to the County Disaster Management Plan has been completed and adopted by the BoCC. We continue to work on support Annexes but have completed annexes for Debris Management, Public Alert & Warning, Mass Care, and EOC activation. In 2022 we will be completing Shelter/Evacuation/Reunification, Animal/Livestock Management, Volunteer/ Donation Management. The Adams County Comprehensive Plan will also be updated in 2022.
Ad Co 4	**Hazard Mitigation Steering Committee.** Broaden and formalize the participation of the Hazard Mitigation Steering Committee to include City representatives and partner organizations. Educate them on the importance of their participation in the plan development process, updates, and other periphery endeavors.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	Adams County OEM; None	TBD; Adams County general fund and Emergency Management grants.	2022-2028	Low	**Annual Implementation;** We continue to engage members of various departments for annual review of hazard mitigation projects and updates. Next meeting 4th Q 2022.
Ad Co 5	**Hazardous Materials Facilities Planning and Regulation.** Investigate the various methods of regulating incompatible land uses. 1. Review of existing zoning regulations. 2. Investigate a new zoning classification, performance standards, buffering requirements for critical facilities from schools, special needs facilities, and critical infrastructure. 3. Develop policies for a coordinated review process internal to the County for all Tier II facilities. 4. Develop integration opportunities between the Local Emergency Planning Committee (LEPC) and the Adams County Planning Commission.	Flooding, Severe Storms, Tornados, Drought, Earthquake, Subsidence, Wildland Fire	Adams County Planning and Development ; None	TBD; Adams County General Fund, Grant Funds	2022-2028	High	**In Progress;** County continues to implement resolutions regarding land use and zoning on a weekly basis. The LEPC is undergoing a revision of by-laws and a review of mission statement.

#	Title and Description	Hazards Mitigated	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
Ad Co 6	**Public Education and Awareness Campaign.** Initiate with municipalities and businesses a collaborative emergency management public education and information program. Investigate effective marketing strategies needed to provide education and information. 1. Design a program to encourage residents and businesses to take preparedness actions on their own behalf. The program should utilize and build upon communication platforms such as Youtube and webinars to educate the public on hazards at most risk to the community. 2. Work with county businesses to develop disaster-resistant business programs. 3. Develop public education and outreach to address ADA requirements for those who have access and functional needs. 4. Develop multi-lingual disaster education for fundamental needs preparedness into the community.	Flooding, Severe Storms, Tornados, Drought, Earthquake, Subsidence, Wildland Fire	Adams County OEM;	Staff time; Adams County General Fund, FEMA Grant Funds	2022-2028	High	**In Progress;** 2022 hired a Community Preparedness and Resiliency Coordinator in the OEM to develop and manage the County Community Preparedness Program.
Ad Co 7	**Regional Park Secondary Power.** Investigate the implementation of a backup generator to help power the pump to the water supply.	Flooding, Severe Storms, Tornado, Wildland Fire, Earthquake	Adams County Parks;	TBD; Adams County Parks	2022-2028	Low	**Not Started;**
27J 1	**Building Schools to Serve as Shelters.** Limit the number and size of interior corridor windows, increase classroom space on the first floors of multi-floor facilities to enable more space for people to take refuge, eliminate sidelight windows, assess older structures to determine the best places for people to take refuge, never use broad-beamed roofed areas such as gyms and auditoriums as places of refuge. Bring people in from modular units to permanent structures when taking refuge.	Severe Storms, Tornado, Earthquake	School District 27J;	TBD; School District 27J general fund, grants.	2022-2028	Medium	**Not Started.** Currently on hold while Tri-County Health transitions to separate county health departments.
TCH 1	**Maintain public health monitoring, surveillance, and emergency response capabilities through the Public Health Emergency Operations Plan (PHEOP).** PHEOP assigns roles and responsibilities to Tri-County Health Department and its divisions. It requires planning, training, and exercising prior to a real-world incident in order for TCHD to respond effectively.	Public Health Hazards	Tri-County Health Department; Partner agencies and organizations identified in the PHEOP	Unknown; TBD	2022-2028	Medium	**Not Started.** Currently on hold while Tri-County Health transitions to separate county health departments.

#	Title and Description	Hazards Mitigated	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
UP 1	**On Going hazard recognition and rectification.** Various are performed every year as outlined in our Capital Plans including relocation/undergrounding of lines to provide more direct and safer routes, increasing capacity of existing infrastructure to improve power quality, and updating outdated equipment	Expansive Soils/ Undermined Areas, preparation for Severe Storms, hardships of power loss	United Power and Tri-State produce annual reports on the progress and serve as leads; TBD	United Power and Tri-State spend in excess of $10 million annually to upgrade, improve and invest in capital projects identified as needing attention by our regular inspections. United Power and Tri-State.	Ongoing	Medium	**Annual Implementation;** Every year we continue to perform maintenance and upgrades as they are identified in our system (whether from an outage or ordinary inspection) just like we added five electric vehicles (four cars and one service truck) it is a gradual replacement process.
UP2	**Fire Mitigation Projects.** To reduce the risk of fires caused by the daily operations of the electrical system, United Power will be implementing several techniques and products. These include, the use of non-expulsion fuses and insulated overhead conductor in the mountainous region of the territory, as well as tree trimming and fault protection across the system.	Wildfire	United Power	TBD; Utility budget	2022-2027	Medium	**New in 2022**
RTD 1	**Environmental Compliance.** Ongoing assignment to RTD's Environmental Compliance program	Hazardous Materials; Water Supply Contamination; Mass Transportation Incident;	RTD Safety & Environmental; Various environmental consultants	$10,000 - $100,000; Other	Ongoing	High	**New in 2022**

6 Plan Implementation and Maintenance

DMA Requirement §201.6(c)(4)(ii):
[The plan shall include] a plan maintenance process that includes: (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle. (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate. (iii) Discussion on how the community will continue public participation in the plan maintenance process.

This section describes how the cities of Thornton, Federal Heights, and Northglenn will implement their mitigation strategies and how the overall Hazard Mitigation Plan will be evaluated and enhanced over time. This includes an overview of the strategy for plan implementation and maintenance, and outlines the method and schedule for monitoring, evaluating, and updating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how the three cities will ensure continued public involvement in mitigation planning.

6.1 Implementation

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, the cities will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

Implementation will be accomplished by adhering to the schedules identified for each mitigation action in the jurisdictions' action plans, and through pervasive efforts to network and highlight the 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.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. Implementation will be accomplished through the routine actions of monitoring agendas, as well as attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

It is also important to maintain a constant monitoring of funding opportunities that can be leveraged to implement actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements, should grants be pursued; this will help ensure that each city is able to capitalize on the opportunity when funding becomes available. Funding opportunities to be monitored include special pre- and post-disaster funds, special district budgeted funds, state and federal earmarked funds, and other grant programs, including those that can serve or support multi-objective applications.

6.1.1 Implementation and Maintenance of the 2017 Plan

As detailed in Section 5.2 and the City Annexes, the three cities have made considerable progress on the implementation of the plan, and on decreasing the vulnerability of the planning area to hazards. The 2017 Plan included a process for implementation and maintenance of the plan in each of the municipalities' annexes, which was generally followed.

The status of mitigation actions and success stories are captured in Chapter 5 and the City Annexes.

6.1.2 Role of the HMPC in Implementation and Maintenance

With adoption of this plan, municipal staff will be tasked with plan implementation and maintenance. This will be accomplished by keeping the HMPC active throughout the lifecycle of the plan. The HMPC will:

- 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, influence, or directly affect increased community vulnerability to disasters,
- Maintain a 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 each jurisdiction's City Council and other partners, and
- Inform and solicit input from the public.

Other duties include reviewing and promoting mitigation proposals, providing technical assistance in implementing mitigation codes and ordinances, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the City websites, in the local newspaper, and on social media.

6.2 Maintenance Strategy and Schedule

The Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan is a living document that may be adjusted or updated as conditions change, actions progress, or new information becomes available. This section describes the method and schedule the cities will follow for monitoring, evaluating, and updating the Plan over the next five years.

6.2.1 Monitoring

Monitoring refers to tracking the implementation of the plan over time. Each City's designated official will be responsible for reaching out to lead and supporting agencies identified in the mitigation actions table for status on those mitigation actions. The Emergency Manager will also coordinate with HMPC members annually every spring to identify and track any significant changes in their agencies' mitigation efforts.

The Cities will use the following process to track progress, note changes in vulnerabilities, and consider changes in priorities as a result of project implementation:

- A representative from the responsible entity identified in each mitigation action 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 may select alternative projects for implementation.
- Projects that were not ranked high priority but were identified as potential mitigation strategies will be reviewed periodically to determine feasibility of future implementation.
- New mitigation projects identified will require an individual assigned to be responsible for defining the project scope, implementing the project, and monitoring the success of the project.
- Mitigation activities not identified as actions in this plan will also be tracked to ensure a comprehensive hazard mitigation program, and to assist with future updates.

A sample meeting agenda and progress report are included as Appendix I.

6.2.2 Evaluation

Evaluating refers to assessing the effectiveness of the plan at achieving its stated purpose and goals. Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan, such as:

- Decreased vulnerability because of implementing recommended actions,
- Increased vulnerability because of failed or ineffective mitigation actions, and/or
- Increased vulnerability because of new development (and/or annexation).

The HMPC will meet annually to evaluate the implementation of the plan and consider any changes in priorities that may be warranted. Each City's Emergency Manager will coordinate with all participating agencies to facilitate an effective maintenance and implementation process. Completed projects will be evaluated to determine how they have reduced vulnerability. Changes will be made to the plan to accommodate for 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.

6.2.3 Updates

The Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan will be reviewed and revised at least once every five years in accordance with the DMA 2000 requirements and latest FEMA and DHSEM hazard mitigation planning guidance. Updates to this plan will consider:

- Has the nature or magnitude of hazards affecting the planning area changed?
- Are there new hazards that have the potential to impact the planning area?
- Have growth and development changed the planning area's vulnerabilities?
- Do the identified goals and actions still address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?
- The updated plan will document success stories where mitigation efforts have proven effective, as well as areas where mitigation actions were not effective, and will include re-adoption by all participating entities following DHSEM/FEMA approval.

6.3 Incorporation Into Existing Planning Mechanisms

Another important implementation mechanism that is highly effective and low-cost is the incorporation of hazard data and mitigation plan principles and recommendations into other plans and mechanisms. Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. The mitigation plan can be considered as the hub of a wheel with spokes radiating out to other related planning mechanisms that will build from the information and recommendations contained herein. Properly implemented, the HMP should serve as one of the foundational documents of the City's emergency management programs, since everything emergency management does should relate back in one way or another to the hazards the jurisdiction faces.

As stated in Section 6.1 above, implementation through existing plans and/or programs is recommended wherever possible. Based on this Plan's capability assessment and progress made on mitigation actions noted in Chapter 5, the City continues to implement policies and programs to reduce losses to life and property from natural and human-caused hazards. The HMPC will be responsible for integrating the data, goals and objectives, and other elements of this Plan into other plans, as appropriate.

The following sections provide some guidance on how the Cities may use the updated HMP to inform and improve other plans, procedures, and programs. For specific actions each city will take, see the City Annexes.

6.3.1 Comprehensive Plans

Integrating hazard mitigation into the comprehensive or general plans of each participating jurisdiction is considered a best practice by both FEMA and the American Planning Association. Future updates to either city's comprehensive plan should seek to integrate hazards data and mitigation goals and objectives from this HMP as much as possible.

6.3.2 Response Plans

Emergency Operations Plans and related response plans should be focused on the hazards identified in the HIRA, particularly those ranked as presenting the highest risk. Hazard information from this HMP update should be incorporated into City EOPs as appropriate during their next update cycle.

Other operational or functional response plans influenced by information contained in the HMP include:

- Damage Assessment Plan: A review of the vulnerability and estimated losses detailed in the hazard profiles can help identify what areas to initially prioritize following a hazard event. Similarly, a review of Section 4.2 Asset Summary can help identify what critical facilities need to be assessed following a hazard event.
- Debris Management Plan: HAZUS runs conducted for earthquake and flood scenarios include an estimate of how many tons of debris would likely be generated by those scenarios. These estimates can be used as bounding limits for how much and what type of debris generation is likely to be required, as well as what areas are most likely to see heavy debris generations.
- Evacuation & Sheltering Plan: A review of the vulnerability and estimated losses detailed in the hazard profiles can help identify what areas are more likely to need evacuation in different hazard scenarios. The Community Profile in Section 2 can help identify not only how many people would potentially be impacted by disasters, but how many are likely to need assistance with transportation, special medical or sheltering needs, etc. This review can also help evaluate the impacts of multiple or cascading hazards, so that evacuees are not relocated into an area that puts them at risk from other hazards.

6.3.3 Recovery Plan

The risk and vulnerability data in the HMP should help inform the post-disaster recovery planning process, especially by ensuring that the recovery elements of those plans fully take into account the dangers posed by other hazards, rather than focusing exclusively on the most recent hazard event. The HMP in turn will be revisited during recovery to help identify opportunities to incorporate mitigation in the recovery and rebuilding process, including maximizing FEMA PA and HMGP funding where applicable.

The FEMA publication "Pre-Disaster Recovery Planning Guide for State Governments" notes:

> "…much of the research involved in the development of mitigation plans can be used to inform the pre-disaster recovery planning effort.
>
> "The pre-disaster recovery planning process will benefit from and build upon hazard mitigation as:
>
> - The mitigation planning process identifies local hazards, risks, exposures, and vulnerabilities;
> - Implementation of mitigation policies and strategies will reduce the likelihood or degree of disaster-related damage, decreasing demand on resources post-disaster;
> - The process will identify potential solutions to future anticipated community problems; and

- Mitigation activities will increase public awareness of the need for disaster preparedness.

"Pre-disaster recovery planning efforts also increase resilience by:

- Establishing partnerships, organizational structures, communication resources, and access to resources that promote a more rapid and inclusive recovery process;
- Describing how hazard mitigation will underlie all considerations for reinvestment;
- Laying out a process for implementation of activities that will increase resilience; and
- Increasing awareness of resilience as an important consideration in all community activities."

6.3.4 Continuity of Operations Plans (COOP)

Continuity of Operations Plans (COOP) and related Continuity of Government (COG) Plans details a jurisdictions' critical functions and how they will protect those functions in order to continue to provide essential services during a disaster or interruption. By defining and describing the hazards facing the County, including frequency and severity, the HIRA informs the COOP plans by giving context to what types of disasters or interruptions are most likely to occur. Critical facilities and assets located in hazard areas should be prioritized for COOP planning.

6.3.5 Capital Improvements Plan

High-dollar mitigation actions listed or identified in the future should be added to the Capital Improvements Plan of each city to ensure that hazard mitigation projects continue to receive funding. The prioritization of actions listed in the mitigation action plans, while not binding on capital improvement planning, can be used to inform the prioritization of those actions. Even projects for which each city intends to seek grant funding may also need to be addressed in the Capital Improvements Plan, given that most mitigation grants require significant local matching funds.

6.3.6 Sustainability Plans

Sustainability is a separate area of concern from hazard mitigation, but there are areas where the two fields overlap and influence one another positively or negatively.

Sustainability plans should be reviewed to identify where there may be synergy between sustainability and mitigation/resiliency. For example, sustainability efforts aimed at increasing a jurisdiction's adaptability to climate change can also make the jurisdiction more resilient to drought and severe weather. Increasing the percentage of food obtained locally could make the jurisdiction more resilient to supply-chain interruptions or the impacts of disasters in other states. Adding more trees and grass to urban areas to reduce the heat island effect could help mitigate the impact of extreme weather events, as well as reducing flood risk by increasing the amount of permeable surfaces. This may help raise the priority of some sustainability efforts, as well as suggest complimentary mitigation efforts.

It is equally important to identify areas where sustainability efforts may work to reduce the jurisdiction's resilience to hazards. For example, a sustainability goal of promoting use of public transit and reducing private car ownership could potentially make it harder to evacuate the public during a disaster if public transit is damaged and offline (as was observed during Hurricane Sandy). Similarly, reduced production of solid waste could lead to a reduction in the number of public resources such as dump trucks, which means that in a disaster those resources would not be available for debris removal and similar tasks. The intent of this review is not to say that sustainability goals should not be pursued, but rather to identify areas of concern that should be considered during implementation of these goals. For example, evacuation plans may need to be revised to reflect a larger percentage of families without cars; or contracts may need to be put in place to obtain additional dump trucks in a disaster.

6.3.7 Public Awareness and Education Programs

Any ongoing public education and outreach efforts conducted by the participating cities should reflect the hazards and vulnerabilities described in this Plan. In addition to preparing for disasters, public education should include ways in which the public can reduce their vulnerability to natural and human-caused hazards. Furthermore, mitigation activities and success stories should be communicated to the public to show the benefits of effective mitigation planning.

6.4 Continued Public Involvement

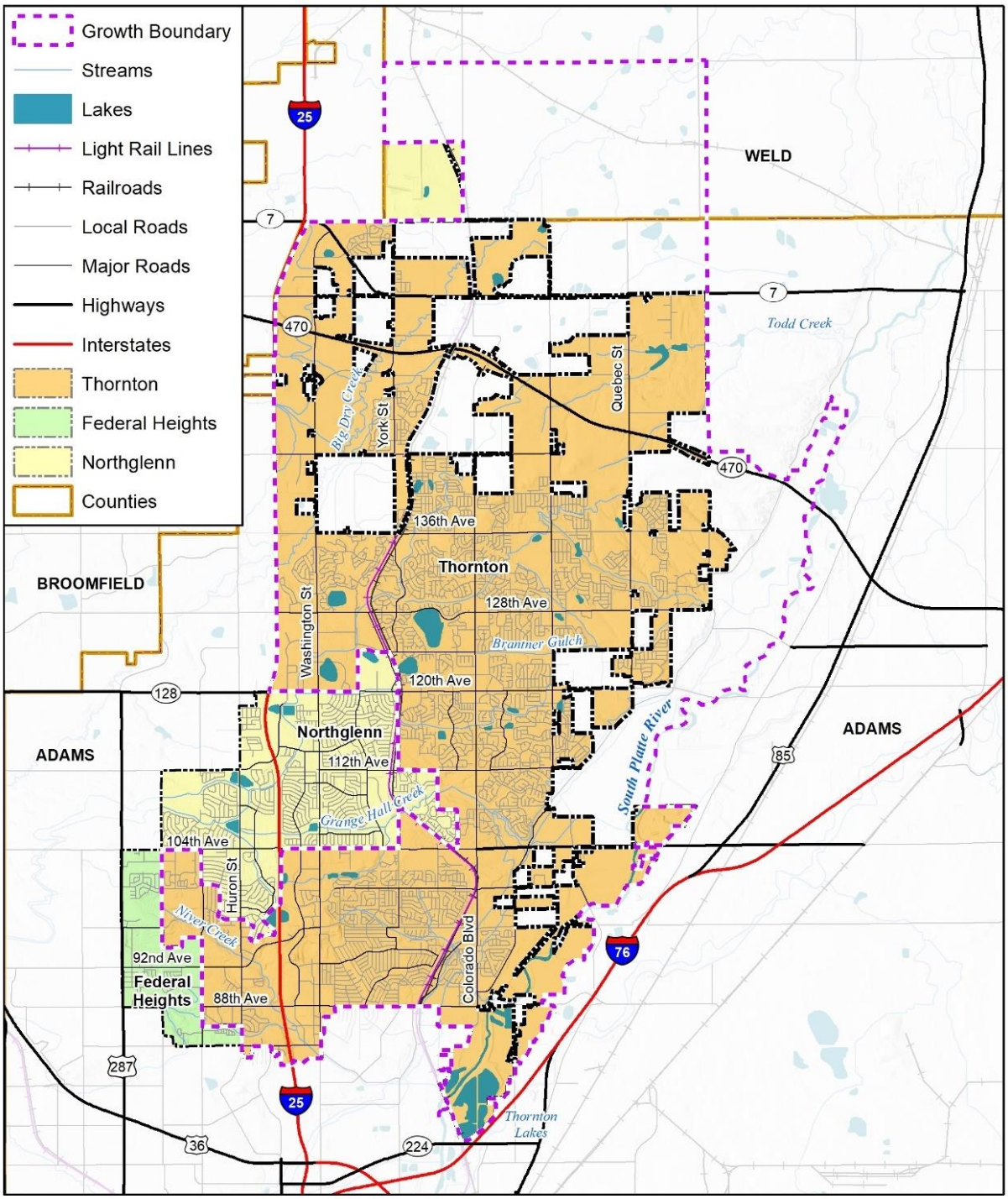
Continued public involvement is also imperative to the overall success of the Plan's implementation. This updated HMP will be posted on each City's website for reference and can be used to help inform the ongoing public education and outreach program, such as the completion of mitigation actions that reduce the community's vulnerability, can be shared with the public through forums like the Adams County Local Emergency Planning Committee (LEPC), public meetings, public preparedness, and resilience trainings, and through social media. This helps keep the concept of hazard mitigation alive and helps show the public that their government officials are working to keep them safe.

The update process provides an opportunity to publicize success stories from the Plan implementation and seek additional public comment. When the HMPC reconvenes for the five-year plan 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. The plan maintenance and update process will include continued public and stakeholder involvement and input through participation in designated committee meetings, surveys, web postings, and press releases to local media.

See the City Annexes for specific activities each City will use to maintain public interest and involvement.

A. The City of Thornton

Figure A-1 The City of Thornton



A.1 Introduction

This Annex was updated as part of the 2022 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan update process. The City of Thornton fully participated in the 2022 update process as described in Section 2, to include:

- Participating in the Hazard Mitigation Planning Committee (HMPC)
- Coordinating between different city departments/agencies and stakeholders
- Updating jurisdictional information
- Identifying new mitigation actions
- Coordinating formal adoption

The City had previously participated in the 2017 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan and has been active in implementing that plan as described in Section A.5. A review of jurisdictional priorities found no significant changes in priorities since the last update.

A.2 Community Profile

The City of Thornton encompasses 24,605 acres northeast of Denver and is the sixth largest city in Colorado in population. It is located within Adams County where its city border mostly lies parallel and just east of the I-25. Broomfield is located northwest of Thornton, with Northglenn, Federal Heights, and Westminster all generally to the west of Thornton. Much like other areas in the Denver metropolitan region, Thornton experienced rapid growth beginning in 2000.

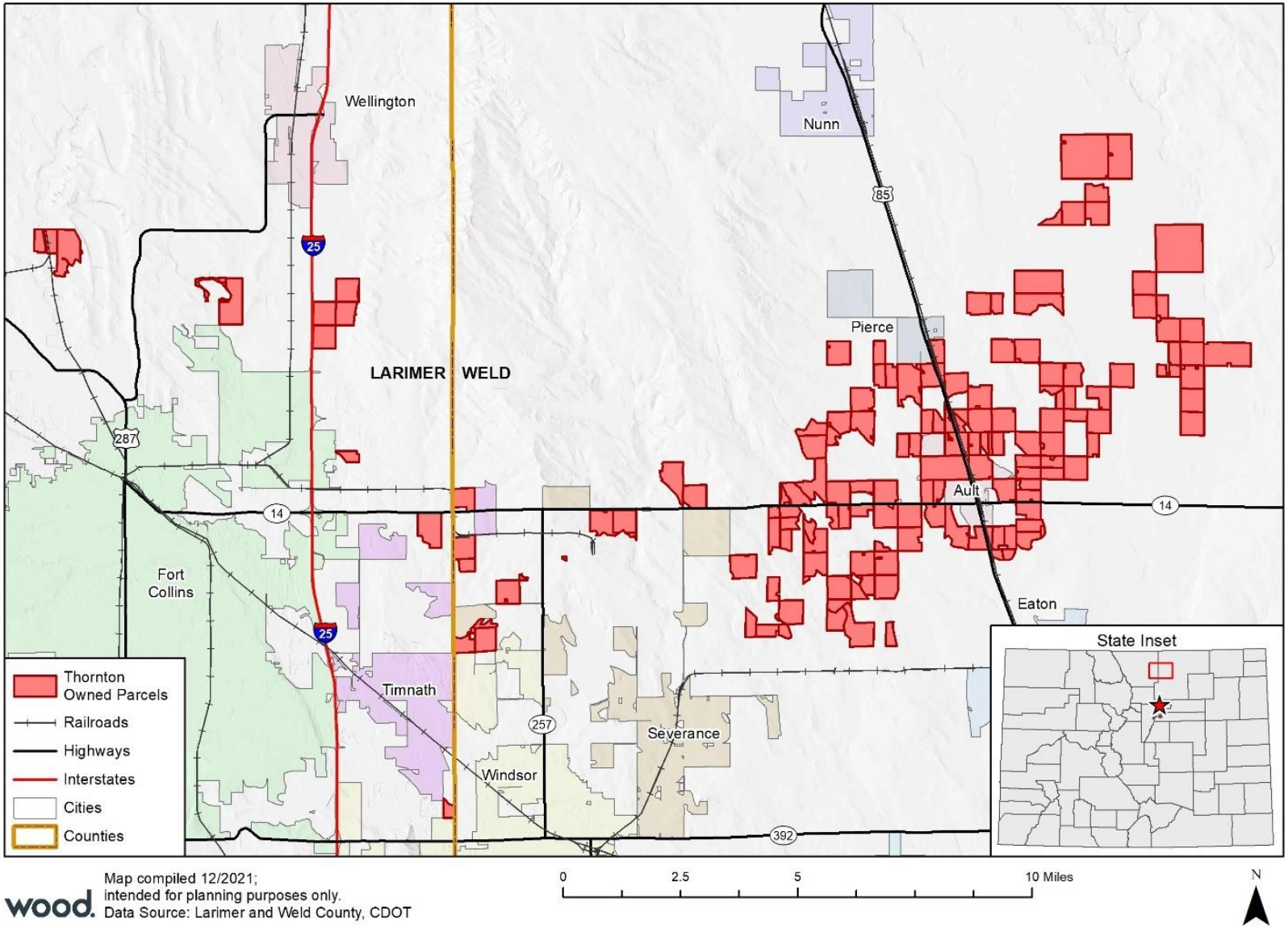
Thornton has identified a growth area of 14,549 acres outside the city limits where expansion is planned. Figure A-1 above shows the City of Thornton and its growth area. The City also owns a number of properties in Larimer and Weld Counties to the north; these properties are shown in Figure A-2.

A.2.1 History

Until 1953, the area now known as the City of Thornton was composed of only farmland. Then, a settler named Sam Hoffman purchased a 640-acre plot of land seven miles north of Denver in hopes of establishing a town. The town that Hoffman designed offered full city services using a single tax levy, such as free trash pickup and recreation opportunities for residents. Hoffman's town became the first planned community located in Adams County. The town was named Thornton after Daniel I.J. Thornton, the Colorado Governor from 1951 to 1955. A group called the Thornton Community Association (TCA) was established in 1954 to help facilitate community development. Within a year, the TCA helped grow the town to over 1,200 homes and 5,500 residents. On June 12th, 1956, Thornton was incorporated as a city and Oyer G. Leary was elected as the first mayor.

Local Thornton historians outline key eras of growth and development within the City. The first era is identified as the "Railroad/Agriculture Era: Pre-1953", or the time before Sam Hoffman purchased the plot of land that would later become the City of Thornton. During this era, development was limited to water, agriculture, and railroad infrastructure. The second era is known as the "Original Thornton Era: 1953-1956". During this time, the community was being quickly developed. It was post-WWII and there was a mass production of homes as well as development of interstate highways. Three original types of model homes were built in the town and street patterns began evolving as neighborhoods were established. The next era of growth is identified as the "Annexation Era: 1972-1986". During this time, there was a proposal to consolidate cities in the area. This encouraged competition between the Cities of Thornton and Northglenn, which caused a period of quick housing development and growth in Thornton.

Figure A-2 Thornton-Owned Properties in Larimer and Weld Counties



The final significant growth event in Thornton is known as the "Northward Expansion Era: 1994-2007" This era is categorized by regional infrastructure investments and sustained housing growth, primarily towards the north end of the city. The population of Thornton has grown from just 5,500 residents in 1955 to 141,867 in 2020, making it the 6th most populous city in Colorado.

In addition, as shown in Figure A-2, Thornton also owns parcels in Larimer and Weld Counties. These parcels are also evaluated in this Annex where appropriate.

A.2.2 Demographics

According to the 2020 Census, the population of Thornton is 144,186. The median age of the population is 33.5 and the median household income is $80,732. Thornton has 8.5% of its population below the poverty level, compared to 10.3% in the State. In 2020, the City was made up of approximately 54.4% Caucasian and 35.2% Hispanic. Also, based on the US Census Bureau ACS 2016-2020 5-year estimate, the City has seen a steady increase of Hispanic populations as well as a slight change in other race/ethnicity categories. In comparison to the Denver metro region, Thornton currently has a higher percentage of Hispanic populations and a similar percentage of Caucasian and a lower percentage of Black or African American populations. The City's population is getting more diverse in general (Community Profile 2018). Moreover, although Thornton has mostly been a community of families, there is a subtle trend that demonstrates an aging population.

Table A-1 Thornton Demographic and Social Characteristics

	Thornton	Colorado	U.S.
Population	144,186	5,773,714	331,449,281
% Growth since 2010	21%	15%	7%
Median Age	33.5	36.7	38.1
Housing Occupancy Rate	96.3%	90.0%	87.9%
% of Housing Units with no Vehicles Available	3.2%	5.1%	8.6%
Median Home Value	$349,000	$343,300	$217,500
Unemployment	4.0%	3.9 %	4.0%
Mean Travel Time to Work (minutes)	30.5	25.8	26.9
Median Household Income	$80,732	$72,331	$62,843
Per Capita Income	$32,589	$38,226	$34,103
% of Individuals Below Poverty Level	8.5%	10.3%	13.4%
% Without Health Insurance	9.6%	7.6%	5.1%
Average Household Size	3.07	2.56	2.62
Households with a broadband internet subscription	92.6%	89.6%	85.2%
% of Population Over 25 with High School Diploma or Higher	87.7%	91.7%	88.0%
% of Population Over 25 with bachelor's degree or Higher	28.3%	40.9%	32.1%
% with Disability	7.8%	10.6%	12.6%
Language other than English spoken at home	24.7%	16.4%	21.5 %

	Thornton	Colorado	U.S.
% Foreign born persons	13.3%	9.5%	13.5%

Source: U.S. Census Bureau, American Community Survey

Table A-2 Thornton Demographics by Race and Sex

	Thornton	%
Total Population	144,186	-
Male	72,135	50.0%
Female	72,051	50.0%
White, not Hispanic	78,367	54.4%
Hispanic or Latino	50,718	35.2%
Asian	7,016	4.9%
Black	3,031	2.1%
American Indian and Alaska Native	382	0.3%
Native Hawaiian/Pacific Islander	12	0.0%
Some other race	288	0.2%
Two or more races	4,372	3.0%

Source: U.S. Census Bureau, American Community Survey

A.2.3 Housing

As shown in Section 3.4 of the base plan, the City of Thornton has 46,868 housing units as of the 2020 Census. 73.3% of those are single-unit structures, 13.4% are apartment buildings with 10 or more units, and 5.8% are mobile homes.

As mentioned in the 2019 City of Thornton Housing Needs Assessment and Analysis of Impediments to Fair Housing Choice, single-family unit production has greatly outpaced multi-family units in recent years. The development of single-family homes, at a variety of price points, will help ensure that incoming residents have access to their preferred housing options and meet the needs of incoming workers. The City of Thornton 2020 Comprehensive Plan also proposed to identify areas around existing and future train stations that can support a greater choice of housing, employment, retail, and/or walkable neighborhoods.

A.2.4 Economy

The largest industries in the City are educational services, and health care and social assistance (16%), professional, scientific, and management, and administrative and waste management services (12%), and construction (12%).

Table A-3 Distribution of Industry Type in Thornton

	Thornton
Full-time, year-round civilian employed population 16 years and over	55,015
Educational services, and health care and social assistance	8,848
Professional, scientific, and management, and administrative and waste management services	6,392
Construction	6,363
Retail trade	5,840
Manufacturing	5,395
Transportation and warehousing, and utilities:	3,828

	Thornton
Public administration	3,755
Finance and insurance, and real estate and rental and leasing	3,512
Arts, entertainment, and recreation, and accommodation and food services	3,106
Other services, except public administration	2,460
Wholesale trade	2,308
Information	2,095
Agriculture, forestry, fishing and hunting, and mining:	1,113

Source: United States Census Bureau

A.2.5 Social Vulnerability

As discussed in Section 3.6 of the base plan, social vulnerability in the City of Thornton varies from low in the northern parts of the City to high in the southern parts. The city is particularly vulnerable in Socioeconomic Status, and Minority & Language Status. By contrast, Housing and Transportation Status ranks relatively low.

A closer look at the individual social vulnerability indicators within Thornton will give local emergency managers, planners, and stakeholders an even clearer picture of where resources should be prioritized in order to reduce vulnerability in the community. It should be noted that even though the city may have relatively fewer people in a SVI category compared to the rest of the state, there are still people in that category who may be disproportionately impacted by disasters. Over time, Thornton should continue to monitor their social vulnerability as demographic, economic, and housing related conditions change.

A.2.6 Future Development

According to the World Population Review, Thornton currently has a 1.45% annual growth rate. Thornton has seen a 24.4% population increase since the 2010 census. Thornton is a fast-growing city that is expected to continue to expand in the decades to come. The 2020 Thornton Comprehensive Plan notes that Thornton is expected to add approximately 50,000 to 65,000 new residents by 2040. Accommodating this growth will require between 17,000 and 23,000 new homes, as well as a range of jobs and services. Established areas of the community have, and will continue to have, very different needs than emerging growth areas from an infrastructure and services standpoint. The types of development and mix of uses that are appropriate in different parts of Thornton will also vary.

Figure A-3 shows a map of future land use from the 2020 Thornton Comprehensive Plan, showing how the City plans to manage growth in the coming years.

Thornton will incorporate information from this HMP update to inform strategic decision making. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan

Figure A-3 Thornton Future Land Use Map

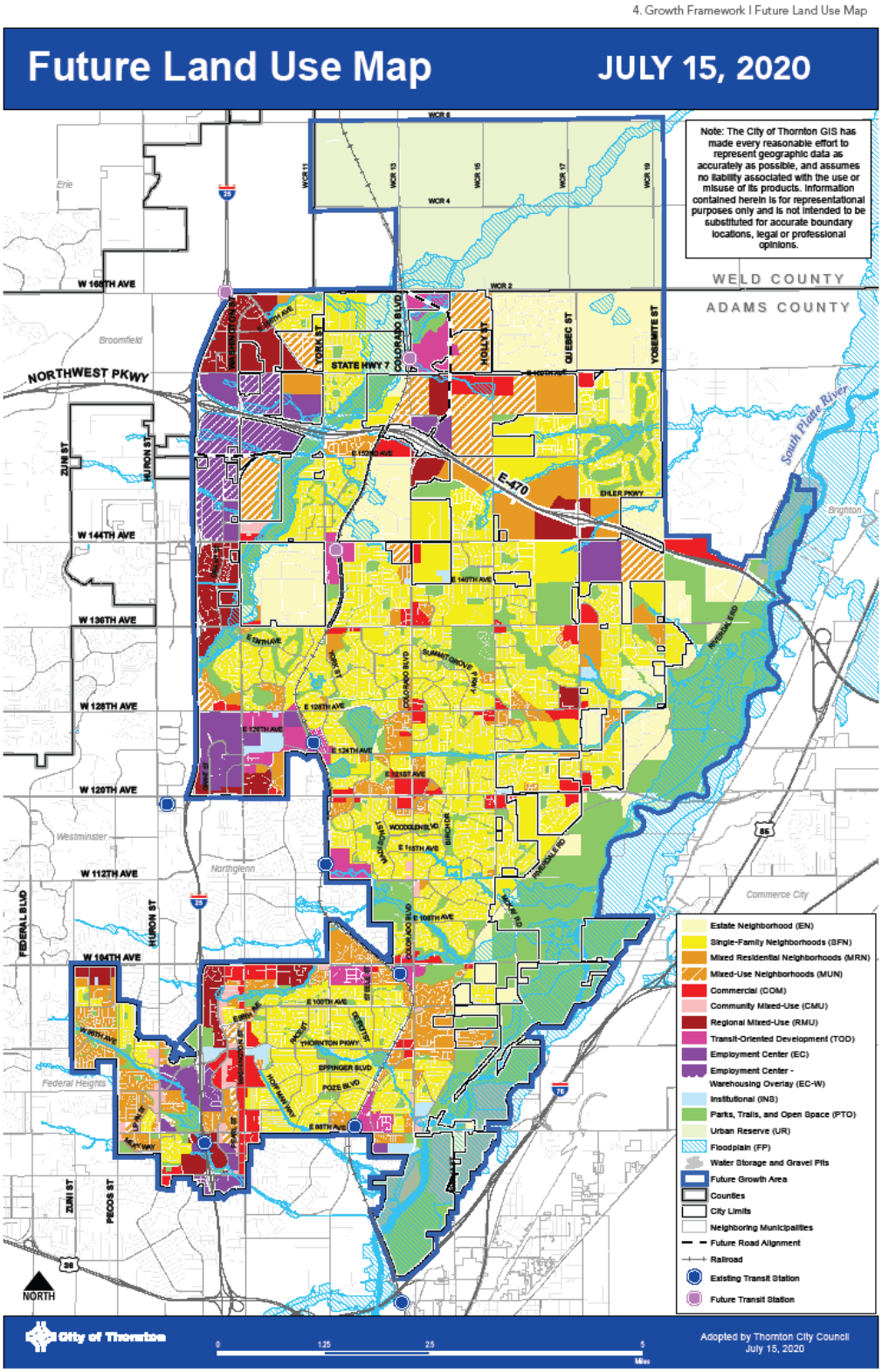


Figure 4-3: Future Land Use Map

4.12

A.2.7 Capability Assessment

Thornton has numerous existing regulatory and planning mechanisms in place that support hazard mitigation planning efforts. These tools include city subdivision regulations and road and bridge standards, and local zoning regulations. Thornton has adopted the 2018 International Building Code.

Thornton is a participant in the National Flood Insurance Program (NFIP). Since it entered the program, the city has adopted the minimum NFIP requirements into its Charter and City Code and Ordinances. Given the flood hazard and risk in City of Thornton and recognizing the importance of the NFIP in mitigating flood losses, an emphasis is placed on continued compliance with the NFIP. 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 and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance. The City also participates in the Community Rating System (CRS) program, and currently holds a Class 6 rating.

Thornton Tomorrow Together Comprehensive Plan (2020)

The Comprehensive Plan serves as the "umbrella" plan that provides guidance for all other planning efforts in the city, such as the more detailed plans and implementation programs. Figure A-4 illustrates how the updated HMP will fall under the category of "Functional Plans" within the Comprehensive Plan. Several of the following plans in this section are also under the "Functional Plan" category of the Comprehensive Plan, alongside the updated HMP. The HMPC looked to the Policies of this Comprehensive Plan to better understand the general aspirations of the Thornton community and how the city plans to evolve and develop over time.

Figure A-4 Plans Guided by the Thornton Comprehensive Plan

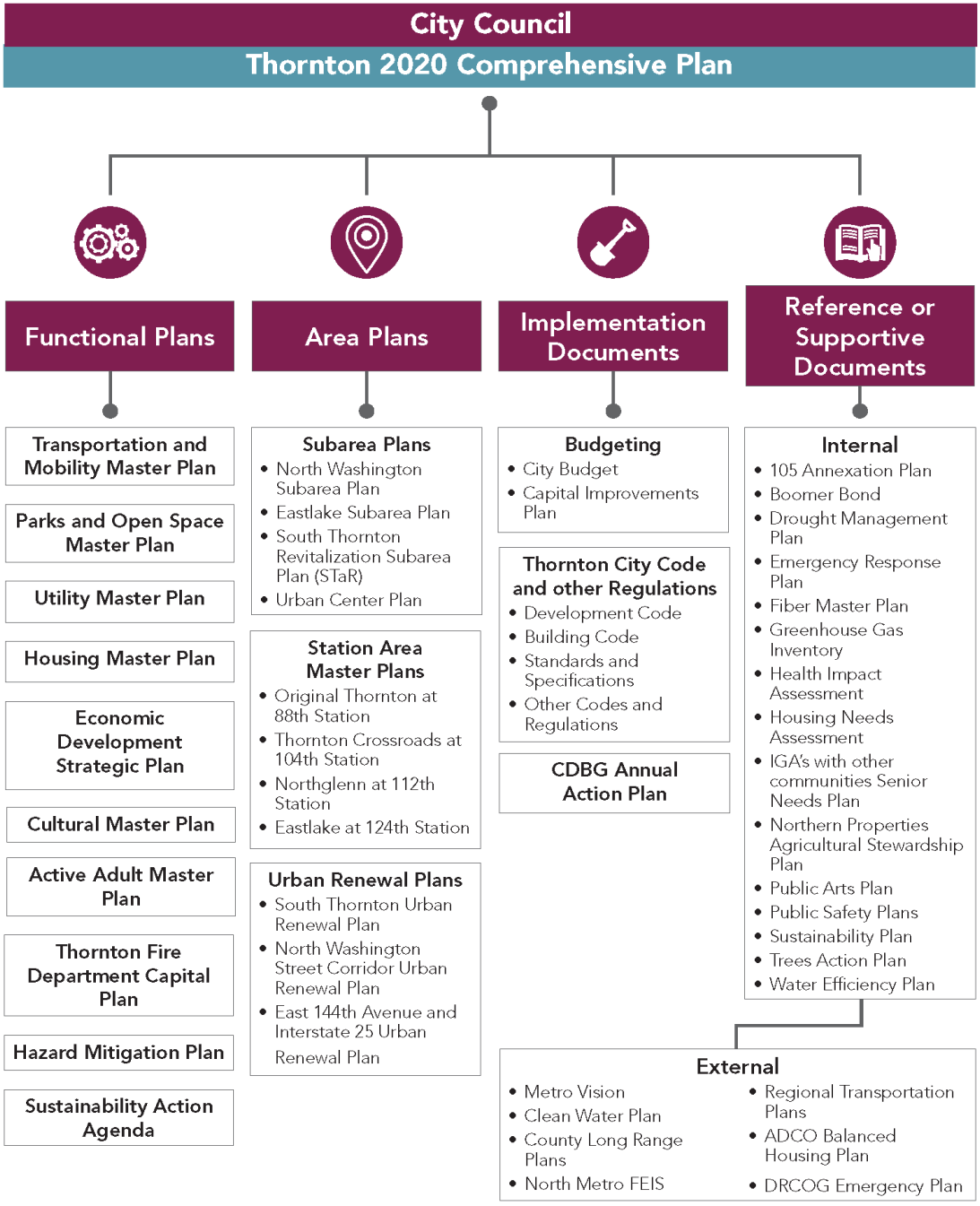


Figure 1-5: Relationship to All Other Plans

Senior Services Master Plan

The Senior Services Master plan seeks to mitigate the issues experienced by senior citizens in the area. The numbers of older adults continue to grow at a rapid rate in the area. Preparation for the growth in this population and the programs and services needed to support them continue to be of concern to both the Board and city council. This plan outlines some of these challenges and recommends specific actions to assist with a broader community approach to addressing the needs of our older adult population. The Senior Citizen Advisory Board presented Thornton City Council with a Senior Services Master Plan comprised of seven issues identified by the Board as areas of concern for Thornton seniors. The Issues identified by the Board include:

1. Diverse Community Housing
2. Centralized Referral Services
3. Senior Programs and Services – Development & Promotion
4. Mobility and Transportation
5. Adapting to Life Changing Events
6. Planning for Present and Future Needs by Expanding or Building New Facilities
7. Health and Wellness Programs

Transportation and Mobility Master Plan

The Transportation and Mobility Master Plan (TMMP) is the City's long-range plan for travel and mobility, guiding future development of transportation-related infrastructure. The overall vision is a transportation network and mobility plan that expands transportation options to enable a resident to access all areas of Thornton in a timely manner without using a private vehicle. Thornton desires a holistic multimodal and mobility view, approach, and evaluation of current and future transportation needs.

The goal of the Plan is to provide an interconnected multimodal transportation network and mobility plan for all people to access goods, services, residences, and employment and accommodates safely moving people, goods, and services using a variety of modes that includes vehicle, bicycle, pedestrian, bus, shuttle, and passenger rail based on the future land use projections and overall vision for the City. As a critical document that supports the 2020 Thornton Comprehensive Plan, the TMMP strives to consider all the transportation-related implications of growth and trends that have emerged in the last decade and anticipate challenges presented by the growing population and number of vehicles on the road.

The City of Thornton Utility Master Plan (UMP)

The City of Thornton Utility Master Plan (UMP) includes Thornton's raw water supply, water treatment facilities, water distribution, and wastewater collection systems. Thornton currently provides service to a population of over 166,000 habitants within the city as well as outside its limits. At build-out, anticipated to occur by 2065, the systems are expected to serve a population of 268,843 within the existing Thornton water and wastewater service areas. To serve the anticipated future growth, the water treatment facilities will require an overall increase in production capacity of an additional 21.5 million gallons per day.

Continuity Plans

The City has 34 Continuity Of Operations (COOP) plans covering all departments and key divisions in the city as part of the Continuity Of Government (COG) Plan. The city utilizes Bold Planning Software to manage COOPs. Updates occur on an annual basis but were put on hold during COVID19; they were last updated by their Department COOP Coordinators in early 2020.

Fire Department

The City of Thornton maintains a full-service Fire Department with six 24-hour fire stations. Each fire response crew consists of a station officer, firefighter/engineer, and firefighter/paramedic. The department also oversees the City's fire safety issues, provides ambulance service, and carries on education and training around a whole spectrum of public safety issues. The City of Thornton Fire Department mitigates the public safety needs of the community by providing services quickly, competently, and compassionately.

The Fire Department is responsible for mitigating emergencies and providing fire and safety education to the community. The Department is comprised of five Divisions: Operations, Prevention, Support Services, Ambulance Services, and Administration. Services provided by these Divisions include: responding to and managing requests for emergency services, including fire, medical treatment and transport; hazardous materials and technical rescue; fire investigations; performing building inspections and pre-plans; interpreting and enforcing the International Fire Code; developing and administering a rigorous training program; educating the public in fire prevention and community safety through community outreach events; planning and directing the Department's operations, resources and development; and performing emergency management planning.

Office of Emergency Management

The Thornton Office of Emergency Management plans, coordinates, and supports activities to reduce community vulnerability and improve resiliency by preparing for, responding to, recovering from, and mitigating impacts to natural and human-caused disasters and large-scale emergencies. The office currently resides within the Fire Administration Division of the Thornton Fire Department. The mission of the Thornton Office of Emergency Management is to have programs and policies to facilitate proactive measures in addressing preparedness, response, recovery, and mitigation in service to the City. Functional responsibilities include:

- Emergency Operations Plan (EOP)
- Hazard Mitigation
- Emergency Operations Center (EOC)
- Emergency Response Support (Fire, EMS, Police)
- Information and Situational Awareness
- Training and Exercise
- Resource Mobilization
- Mutual Aid and Intergovernmental Agreements
- Support Local Emergency Planning Committee (LEPC)
- Continuity of Operations Planning (COOP)
- Disaster Recovery
- Community Preparedness Education

Police Department

The mission of the Thornton Police Department is to serve and protect our community. The department does this through a tradition of providing high quality police services, deterring crime by engaging in effective partnerships, collaborative problem solving and mentoring youth. The three key division of the Thornton Police Department are:

- Patrol Division: The Patrol Division provides the community with around the clock, professional police service and is responsible for crime prevention, as well as responding to calls for service. The duties of the Patrol Division are to deter and investigate criminal activity, solve community related problems in

a collaborative effort with the community, conduct traffic enforcement and accident investigation, and provide for the care and control of animals.

- Detective Division: The Detective Division is primarily responsible for the criminal investigation of assigned felony/misdemeanor crimes that meet designated solvability factors. Successful investigations by the division will typically culminate in an arrest, arrest warrant, felony summons, case referred to another agency, or a determination made that the reported crime did not occur.
- Administrative Division: The Administration Division serves a support role to the Patrol Division and the Detective Division. The primary operational areas within the division include the Police Records Unit, Chaplain's Unit, Planning and Research, Community Relations/Public Information Officer, Crime Analysis Unit, Automated Systems Support, Administrative Support, Procurement and Purchasing and the Emergency 911 Communication Center.

Department of Planning and Zoning

The Current Planning Division at the City of Thornton is charged with overseeing and controlling development within the City. This is accomplished through reviewing and providing recommendations on: applications for Annexation, Rezoning and Subdivision of land, Conceptual Site Plans, Temporary Use Permits, proposed architecture for new buildings and additions, building permits, and minor amendments to approved projects.

Public Safety Communications

The Police and Fire Departments and City Court system are key components of that commitment. Another key component of the public safety communications is the use of CodeRED. Code RED is a reverse 911 system that is used in the City to send information to the public. Examples of information send with Code RED include evacuation notices, bio-terrorism alerts, boil water notices, severe weather, and missing child reports. Other communication sources include Thornton Cable TV, ThortonCo.gov, Facebook, Twitter, and Nextdoor.

Opportunities for Improvement

While the City has a number of strong capabilities that can be used to support mitigation, there are several areas where those capabilities could be enhanced or improved. Additional training on mitigation for key city staff would help strengthen existing mitigation capabilities and programs. The City could also look at building its capability to plan for hazard reduction, resiliency, and transportation, possibly in coordination with the other cities or Adams County. Formalizing a sustainability plan and providing funding to support sustainability projects would help reduce environmental impact, diversify energy sources, and improve quality of life for residents. The City could also consider improving its Community Rating System (CRS) score.

A.3 Hazard Identification and Risk Assessment

This section supplements Section 4 of the Base Plan by providing a refined vulnerability assessment specific to the City of Thornton for those hazards where the risk is significantly different from that of the planning area overall, or where sufficient data exists to conduct mapping and analysis at the municipal level. The risk for each hazard may vary slightly between the three cities due to specific hazard risk and vulnerabilities unique to that jurisdiction. This helps to differentiate the jurisdiction's risk and vulnerabilities from that of the planning area overall.

A.3.1 Hazard Identification and Ranking

Table A-4 lists the significance of each hazard for the City of Thornton based on the risk assessment and planning team input. The highest risk hazards were determined to be flood, public health hazards, and severe cold weather storms.

Table A-4 Hazards Summary – City of Thornton

Hazards	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Cyber Attack	Significant	Limited	Likely	**Medium**
Dam Failure	Limited	Critical	Unlikely	**Medium**
Drought & Excessive Heat	Extensive	Moderate	Likely	**Medium**
Earthquake	Extensive	Critical	Unlikely	**Low**
Expansive Soils	Extensive	Negligible	Likely	**Medium**
Flood	Significant	Moderate	Likely	**High**
Ground & Surface Water Supply Contamination	Extensive	Critical	Occasional	**Medium**
Hazardous Materials	Significant	Moderate	Likely	**Medium**
Mass Transportation Incident	Significant	Moderate	Occasional	**Medium**
Public Health Hazards	Extensive	Critical	Occasional	**High**
Severe Cold Weather Storms	Extensive	Critical	Highly Likely	**High**
Severe Warm Weather Storms	Extensive	Moderate	Highly Likely	**Medium**
Terrorism & Active Shooters	Significant	Critical	Occasional	**Medium**
Tornadoes & Microbursts	Limited	Moderate	Likely	**Medium**
Wildland Fire	Significant	Moderate	Likely	**Medium**

Location/Spatial Extent
Extensive: 50-100% of planning area
Significant: 10-50% of planning area
Limited: Less than 10% of planning area

Potential Severity
Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged
Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged
Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.

Potential of Future Occurrence
Highly Likely: Near 100% probability each year.
Likely: Between 10 and 100% probability per year or at least one chance in ten years.
Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Significance
(Based on the preceding three factors)
High: widespread potential impact
Medium: moderate potential impact
Low: minimal potential impact

The following sections detail vulnerability to specific hazards, where quantifiable, and where it differs from that of the other cities. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas. For a discussion of the methodology used to develop the loss estimates refer to Section 4 of the Base Plan.

For the following hazards, the City's risk does not differ significantly from the rest of the planning area, and they are not profiled further:

- Cyber Attack
- Drought & Excessive Heat
- Ground & Surface Water Supply Contamination
- Hazardous Materials
- Severe Warm Weather Storms
- Terrorism & Active Shooters
- Tornadoes & Microbursts

See Section 4.2 for a discussion of assets at risk in the City.

A.3.2 Dam Failure

The risk of dam inundation is significantly higher in the City of Thornton, primarily in the existing floodplains of the South Platter River and Big Dry Creek. An estimated $1.3 billion in total property value and 6,372 people are exposed to this hazard in Thornton. An additional $132 million in property value and 1,647 people in the City's growth area are exposed to risk of dam inundation.

Dam inundation is also a risk for several city-owned properties in Larimer and southwestern Weld Counties. The are 10 buildings worth $1.1 million potentially at risk, but no residents.

The City has prepared an Emergency Action Plan for the Niver Creek Detention Dam. There is also a jurisdictional dam on the NW corner of 152nd and Holly St.

See Section 4.4.7 of the base plan for detailed property exposure and critical facilities at risk.

Dam inundation maps for the City, its growth area, and city-owned properties in Larimer and Weld Counties are included in Appendix H.

A.3.3 Earthquake

The following information details the results of the Hazus-MH scenario summary report specific to the city of Northglenn. Impacts on persons and households in the planning area were estimated for the 2,500-Year Probabilistic Earthquake. Impacts to the population as estimated by Hazus are detailed in Table A-5. It is estimated in a 2 p.m. time of occurrence scenario, which is likely to be a worst-case scenario, that there would be 38 injuries across the city, four of which would require hospitalization. One fatality is estimated in Thornton.

Table A-5 Estimated Earthquake Impact on Persons and Households in Thornton

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter	Number of Casualties
2,500-Year Earthquake	52	34	39

Source: Hazus-MH Global Summary Report, Wood analysis

Table A-6 Estimated Building Damage by Occupancy in Thornton

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	62.66	0.17	6.82	0.21	3.75	0.30	0.74	0.44	0.03	0.42
Commercial	1147.20	3.18	147.56	4.44	81.26	6.59	16.18	9.65	0.80	10.98
Education	34.24	0.09	3.58	0.11	1.86	0.15	0.31	0.19	0.01	0.20
Government	19.94	0.06	2.50	0.08	1.34	0.11	0.21	0.13	0.01	0.15
Industrial	358.02	0.99	47.83	1.44	28.21	2.29	5.74	3.43	0.20	2.82
Other Residential	2610.82	7.23	543.74	16.35	355.36	28.81	31.87	19.01	1.22	16.75
Religion	82.15	0.23	8.74	0.26	4.38	0.36	0.69	0.41	0.04	0.49
Single Family	31784.47	88.05	2565.31	77.13	757.37	61.40	111.89	66.75	4.95	68.19
Total	**36,099**		**3,326**		**1,234**		**168**		**7**	

Source: Hazus-MH Global Summary Report, Wood analysis

The Hazus analysis model estimates about 1,408 buildings in Thornton will be at least moderately damaged. This is over 3% of the buildings in the city. Seven buildings are estimated to be damaged beyond repair. Most of the damage will be concentrated in single-family residential structures. Total

building related losses were estimated to be $130.27 million. A summary of these damage estimates is included in Table A-6 and Table A-7.

Table A-7 Hazus Building Related Economic Loss Estimates for 2,500 Year Scenario

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0693	2.3167	0.0894	0.1261	2.6015
	Capital-Related	0.0000	0.0294	2.0462	0.0531	0.0274	2.1561
	Rental	1.8236	0.7637	1.4252	0.0394	0.0622	4.1141
	Relocation	6.4213	1.0947	2.0752	0.2674	0.4342	10.2928
	Subtotal	**8.2449**	**1.9571**	**7.8633**	**0.4493**	**0.6499**	**19.1645**
Capital Stock Losses							
	Structural	11.2270	2.1070	2.8386	0.5959	0.5300	17.2985
	Non_Structural	43.9743	10.9321	7.3127	2.1800	1.4919	65.8910
	Content	17.4011	3.0638	4.5798	1.4628	0.9667	27.4742
	Inventory	0.0000	0.0000	0.1592	0.2629	0.0183	0.4404
	Subtotal	**72.6024**	**16.1029**	**14.8903**	**4.5016**	**3.0069**	**111.1041**
	Total	**80.85**	**18.06**	**22.75**	**4.95**	**3.66**	**130.27**

Source: Hazus-MH Global Summary Report, Wood analysis

A.3.4 Expansive Soils and Undermined Areas

Large portions of the City are at moderate risk of expansive soils, as shown in Figure A-5.

None of the City-owned properties in Larimer and Weld Counties are on areas known to be at increased risk of expansive soils, although there are some areas nearby. However, some are located on or near areas at risk of collapsible soils, which are a group of soils that can rapidly settle or collapse the ground. The most common type of collapsible soil is hydrocompactive soil. According to the CGS, hydrocompactive soils form in semi-arid to arid climates in the western US and large parts of Colorado in specific depositional environments. These soils are low in density and in moisture content and are loosely packed together. Agents that bind these loosely packed particles together, such as clay and silk buttresses, are water sensitive. When water is introduced to these soils, the binding agents may quickly break down, soften, disperse, or dissolve. This results in a reorganization of the soil particles in a denser arrangement, which in turn results in a net volume loss indicated by resettlement or subsidence at the surface. Volume loss can be between 10 to 15%, which can result in several feet of surface-level displacement.

Additionally, some of the properties contain alluvial mud and debris flows, which may be indicative of past flooding or landslides. Soil hazards to the area are shown in Figure A-6.

Figure A-5 Expansive Soils Risk to the City of Thornton

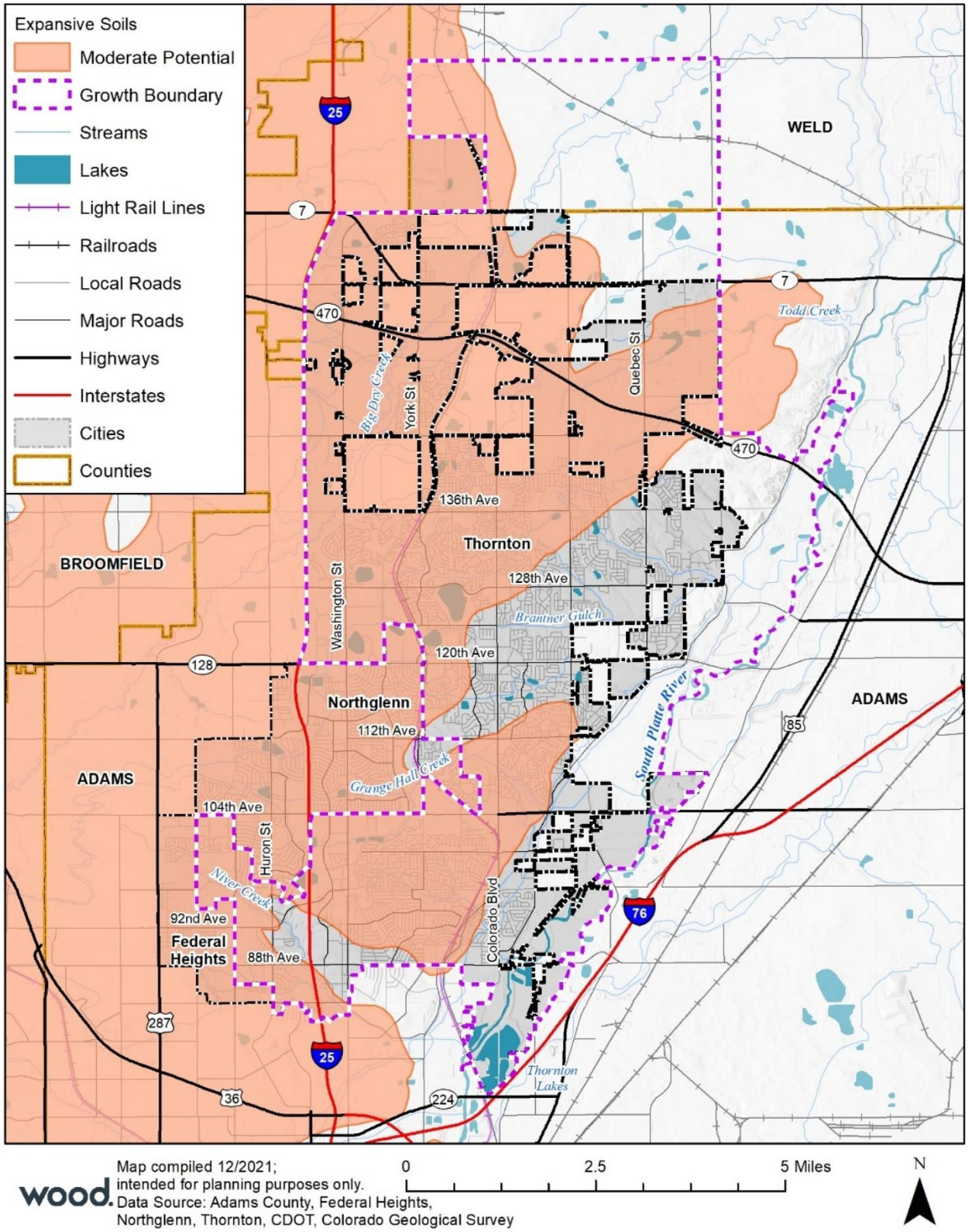
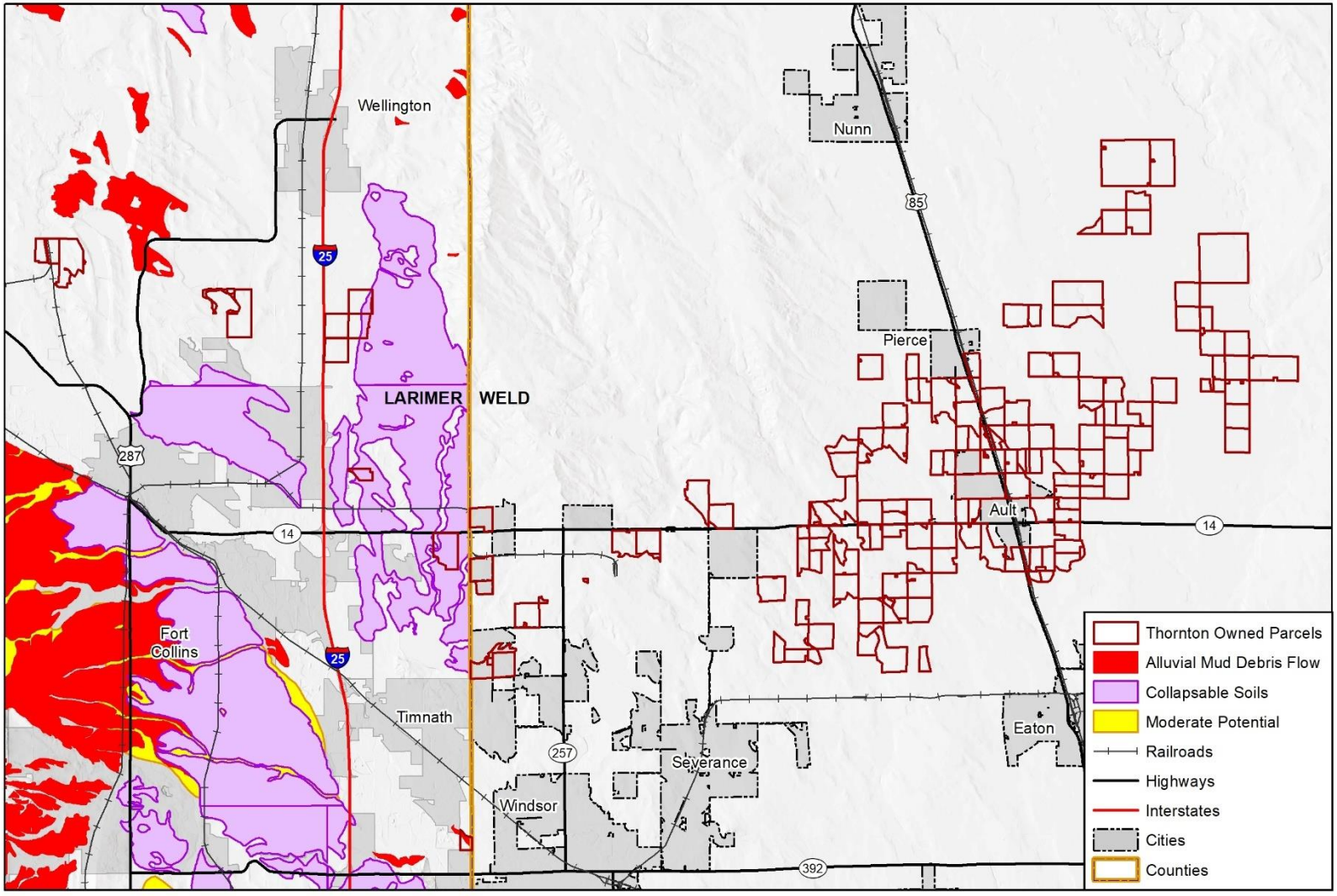


Figure A-6 Soils Risk to Thornton-Owned Properties in Larimer & Weld Counties



Map compiled 12/2021;
intended for planning purposes only.
Data Source: Larimer and Weld County, CDOT, Colorado Geological Survey

A.3.5 Flood

Flood risk in the City of Thornton is high. The FEMA 1% annual floodplain in the City contains 144 residents and 68 buildings, 48 of which are residences; estimated flood losses are over $29 million. The 1% annual floodplain in the growth area includes an additional 233 residents and 123 structures, 78 of which are residences; estimated flood losses are $14 million. The city-owned properties in Larimer and Weld counties include 6 structures, but no residents; estimated flood losses are around $171,000. There are also 51 critical facilities at risk in the City, and 29 in the growth area.

The City's 0.2% annual chance floodplain contains an additional 395 residents and 136 structures, 132 of which are residences; total estimated losses are over $95 million. In the growth area there are 12 residents and 7 buildings; estimated losses are around $765,000. There is only one city-owned parcel in Larimer/Weld counties in the 0.2% floodplain, with no residents and one structure with $53,000 in estimated losses. There are 5 critical facilities at 0.2% risk in the City, and 3 in the growth area.

The mapping studies done by the Mile High Flood District (MHFD) show significantly more risk in Thornton. The MHFD 1% annual mapped areas in the City contains 580 residents and 209 buildings, 194 of which are residences; estimated flood losses are over $39 million. The 1% annual mapped areas in the growth area includes an additional 105 residents and 47 structures, 35 of which are residences; estimated flood losses are $4 million.

The MHFD 0.2% annual chance mapped areas contains an additional 138 residents and 47 structures, 46 of which are residences; total estimated losses are over $44 million. There are no mapped 0.2% chance areas in the growth area in the MHFD study. Note that the more recent MHFD studies determined that a number of parcels in FEMA's 0.2% areas were actually at a 1% annual risk.

FEMA-mapped flood hazard areas in Thornton are shown in Figure A-7. Figure A-8 shows the more recent MHFD mapping. Figure A-9 shows the FEMA-mapped flood threat to the city-owned properties in Larimer and Weld Counties.

NFIP Participation

Thornton joined the National Flood Insurance Program (NFIP) on June 15, 1978. There are currently 50 NFIP-insured properties in the City, with a combined coverage of $13,476,900. There have been 11 damage claims filed under the NFIP in Thornton, and a total of $33,770 has been awarded.

Currently available NFIP data does not give enough information to determine the number of NFIP-insured properties in the growth area, or the city-owned properties in Larimer and Weld Counties.

As discussed in Section 4.8.7, there is one Repetitive Loss (RL) property in the City of Thornton, a single family residential structure that has suffered two flood losses: one during the September 2013 floods and again during the May 2015 flooding. There are no Severe Repetitive Loss (SRL) properties in the City of Thornton.

Figure A-7 FEMA Flood Hazards in the City of Thornton and Growth Area

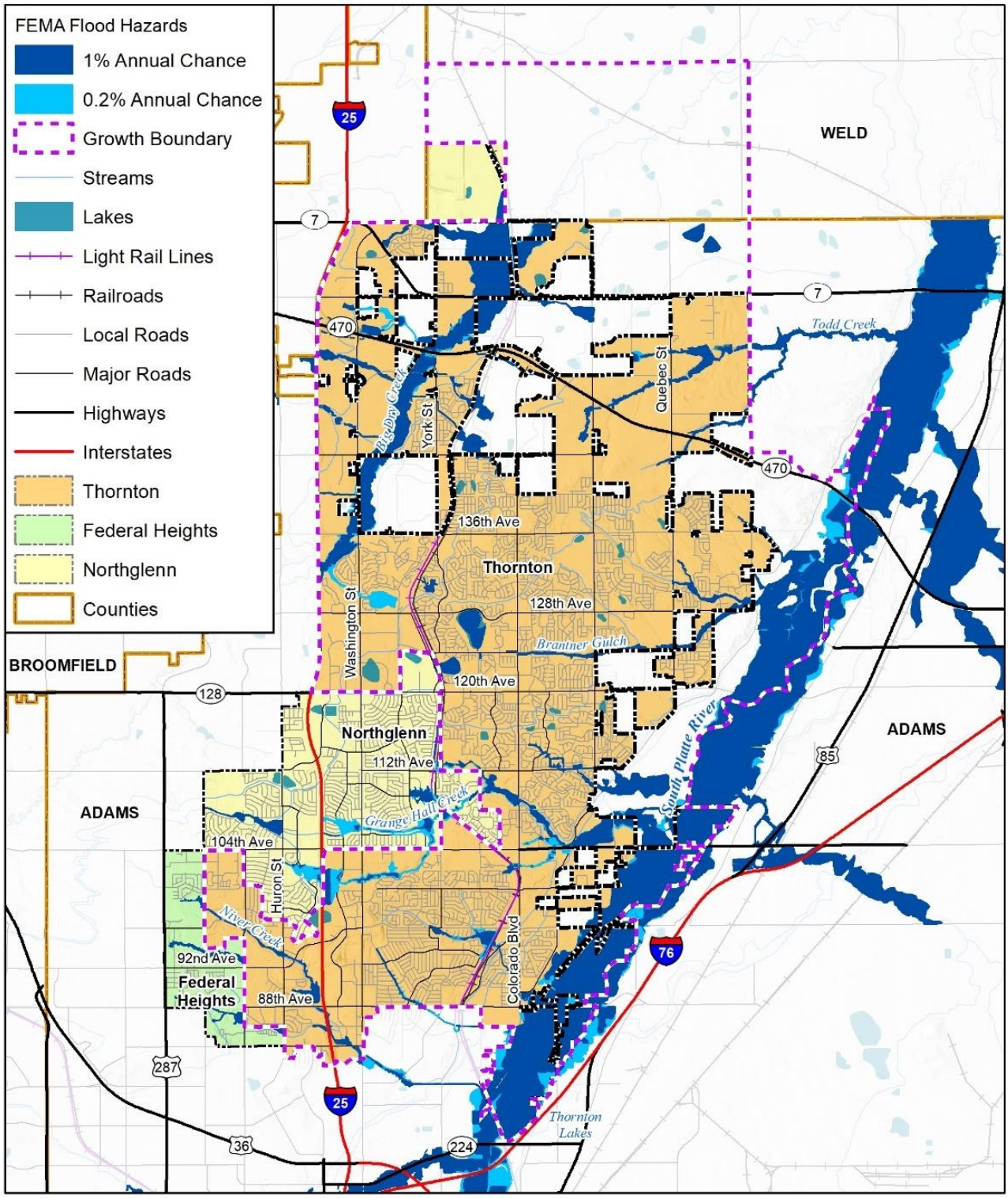


Figure A-8 MHFLD Flood Hazards in the City of Thornton and Growth Area

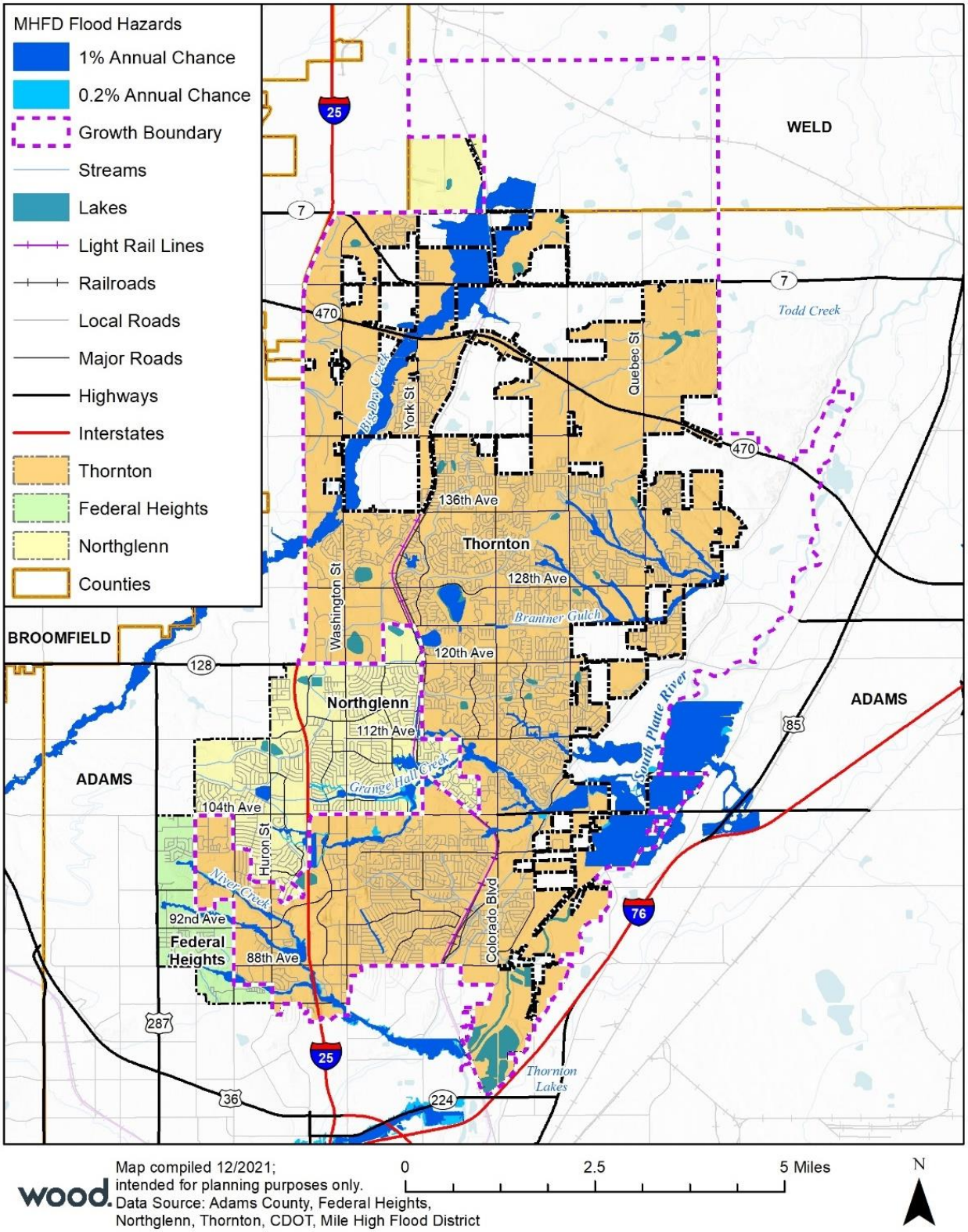
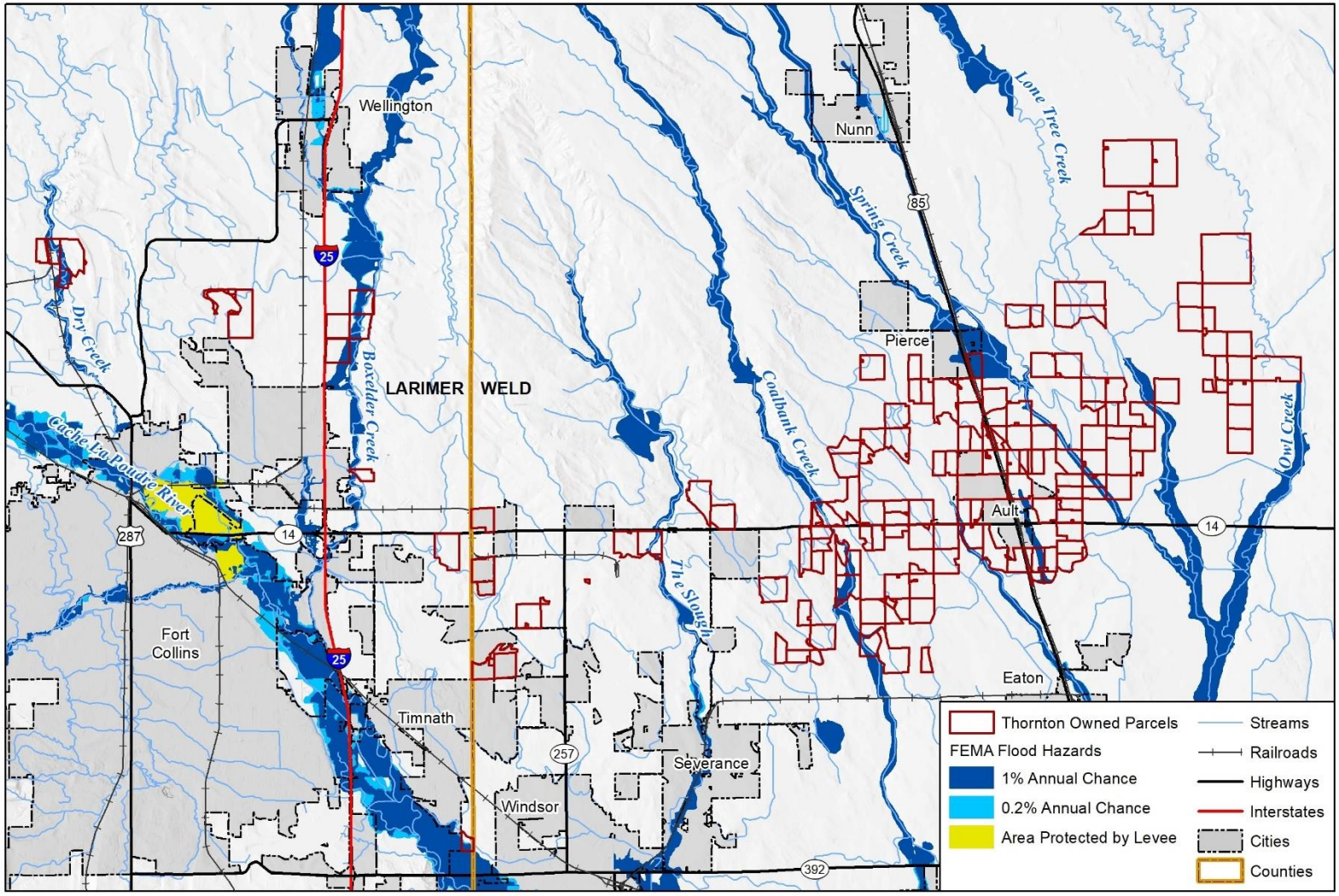


Figure A-9 FEMA Flood Hazards to Thornton-Owned Properties in Larimer & Weld Counties

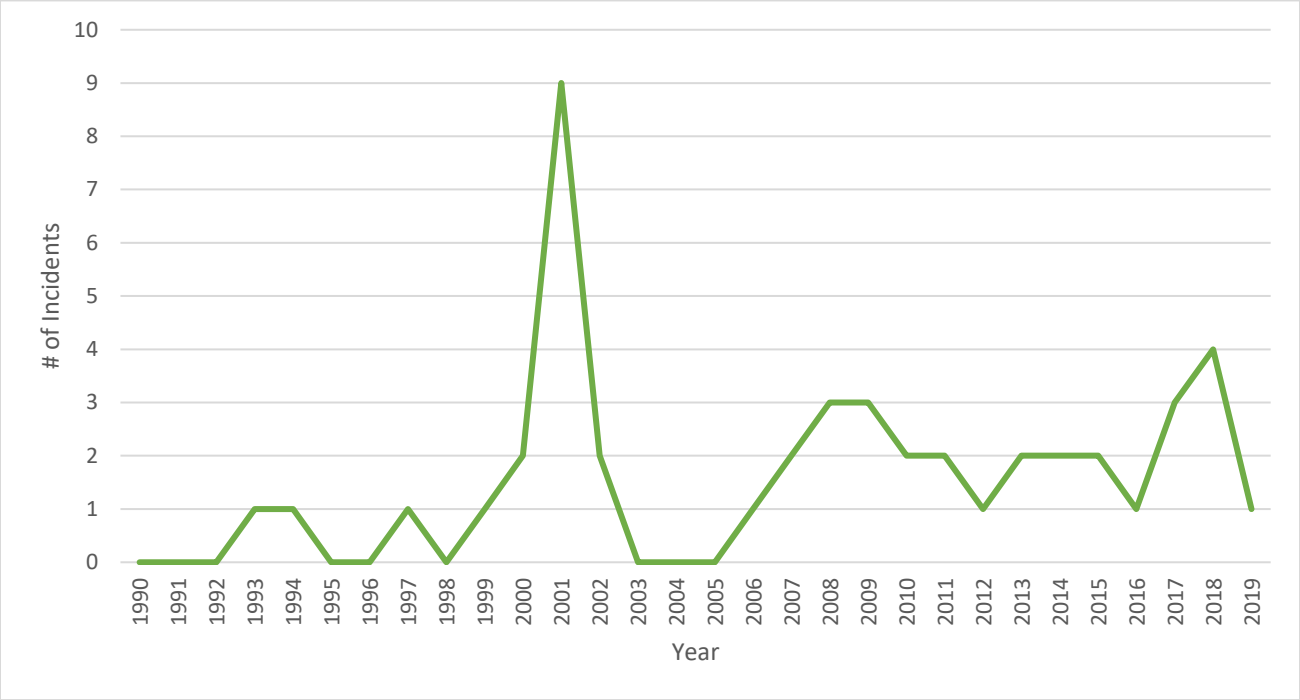


Map compiled 12/2021;
intended for planning purposes only.
Data Source: Larimer and Weld County, CDOT,
FEMA NFHL Effective Larimer County 1/15/2021 & Weld County 1/20/2016

A.3.6 Hazardous Materials Incidents

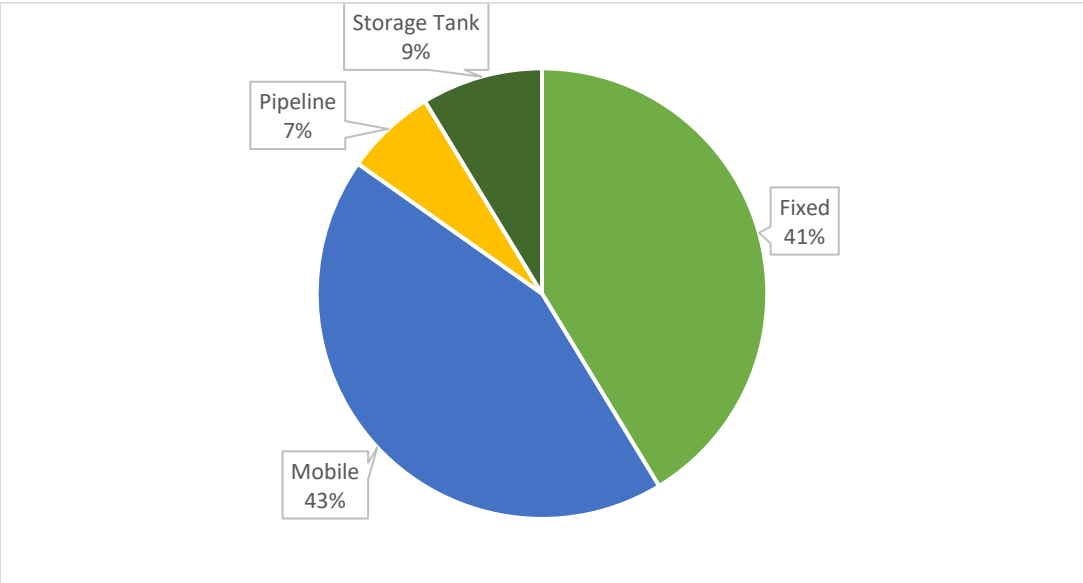
Between 1991 and 2019 there have been 46 hazardous material incidents in Thornton. In total, these incidents resulted in five casualties (1 fatality and four injuries). None of the incidents resulted in property damages. A majority of past hazardous material incidents in Thornton were mobile incidents.

Figure A-10 Number of Hazardous Material Incidents in Thornton, 1991-2019



Source: NRC

Figure A-11 Types of Hazardous Materials Incidents, 1991-2019



Source: NRC

A.3.7 Mass Transportation Incident

Interstate 25 runs north-south through portions of Thornton to the south and run parallel to portions of the city in north where it meets E-470. The N Line, a commuter rail line, and portions of the Union Pacific line also crosses through the city. Table A-8 shows there have been 25,955 automotive crashes in Thornton between 2010 and March 3, 2022.

Table A-8 Thornton Automotive Crashes 2010-March 3,2022

Number of Crashes	25,955
Number Of Fatal Crashes	68
Number Of Fatalities	169
Number Of Non-Motorist Fatalities	29
Number Of Serious Injury Crashes	485
Number Of Serious Injuries	3,045
Number Of Non-Motorist Serious Injuries	471

Source: CDOT Colorado Crash Data Dashboard

A.3.8 Public Health Hazards

Given the fact that cities are ideal breeding grounds for epidemics and virus can grow exponentially in air travel, the impact of public health hazards including pandemic and endemics on Thornton is likely to be very similar to that of the planning area as a whole. Public health responses are typically coordinated at the county level.

As of July 1, 2022, the City of Thornton had experienced 38,056 cases of COVID-19, resulting in 1,621 hospitalizations and 290 deaths.

A.3.9 Severe Cold Weather Storms

Severe cold weather storms typically present similar risks across the planning area; however, jurisdictions with high numbers of elderly residents, a high poverty rate and/or large numbers of rental properties can plan accordingly to provide appropriate services and mitigation assistance during extreme cold weather storm events.

Compared to the State average, the City of Thornton has a slightly lower percentage of elderly residents, people below the poverty level, and renter-occupied housing. Therefore, social vulnerability to severe cold weather storms may be slightly lower in Thornton than the rest of the planning area.

A.3.10 Wildland Fire

The risk from wildfires in Thornton is **Medium**, but higher than the rest of the planning area. There are an estimated 15,380 Thornton residents living in wildfire risk area, although 10,591 (69%) of them are at the lowest wildfire risk category. There are a total of 5,361 buildings in wildfire risk areas, 580 at moderate risk, 776 at low risk, and 3,725 at the lowest risk; the combined value of properties at risk is $5 billion, although $3.9 billion of that are at the lowest risk. The City has 7 critical facilities at moderate wildfire risk are in the city, 10 at low risk, and 40 at lowest wildfire risk.

An additional 4,583 people in the growth area live in areas of wildfire risk, evenly distributed between lowest, low, and moderate risk. There are a total of 1,692 buildings in wildfire risk areas, 506 at moderate risk, 580 at low risk, and 606 at the lowest risk; the combined value of properties at risk is $816 million. The growth area has 9 critical facilities at moderate wildfire risk are in the city, 17 at low risk, and 23 at lowest wildfire risk.

The December 2021 Marshall Fire in Boulder County showed how deadly wildfires can be if high winds drive them into an urban area, potentially threatening the entire City.

Figure A-12 Wildfire Risk in Thornton

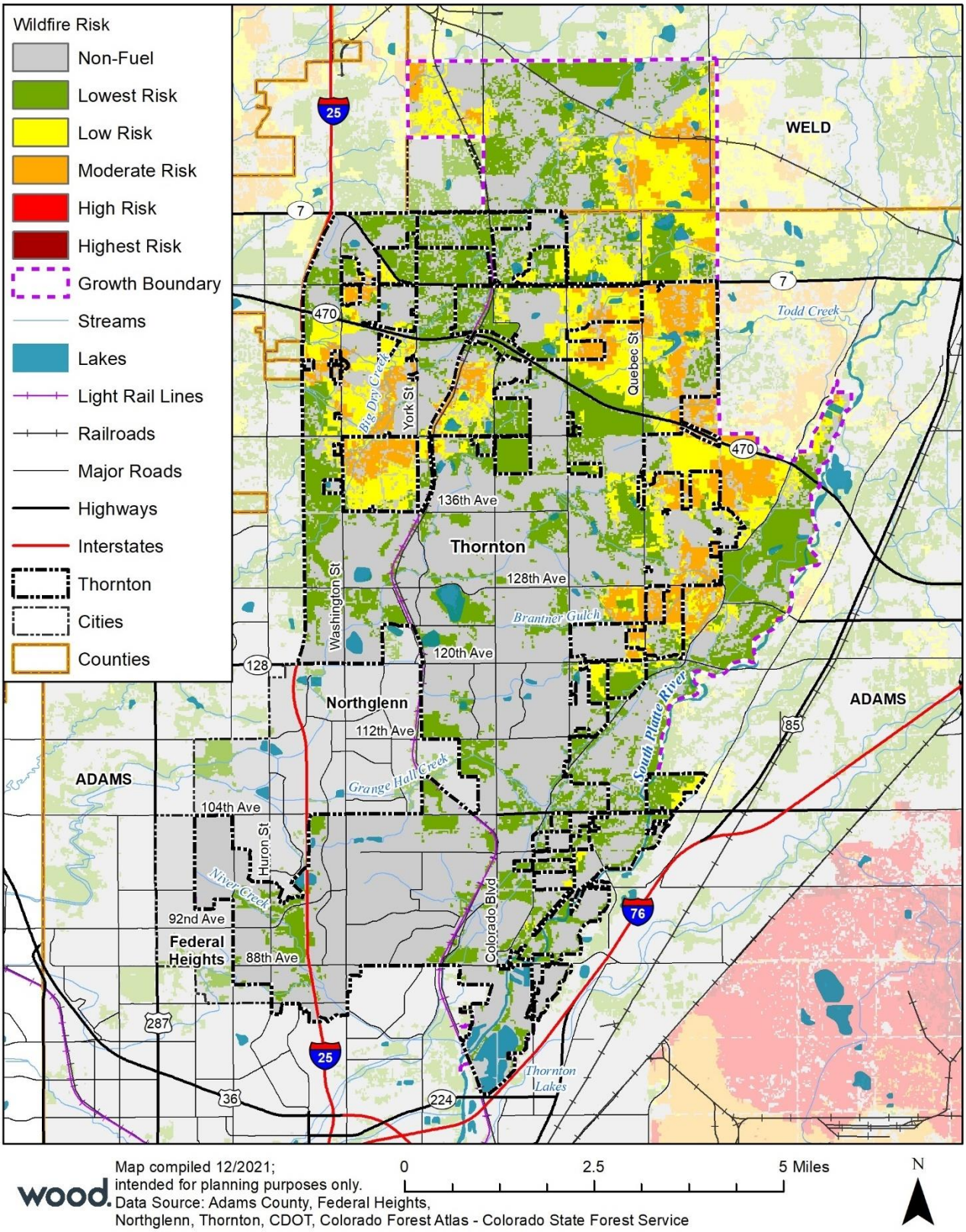


Figure A-13 Wildfire Urban Interface (WUI) Areas in Thornton

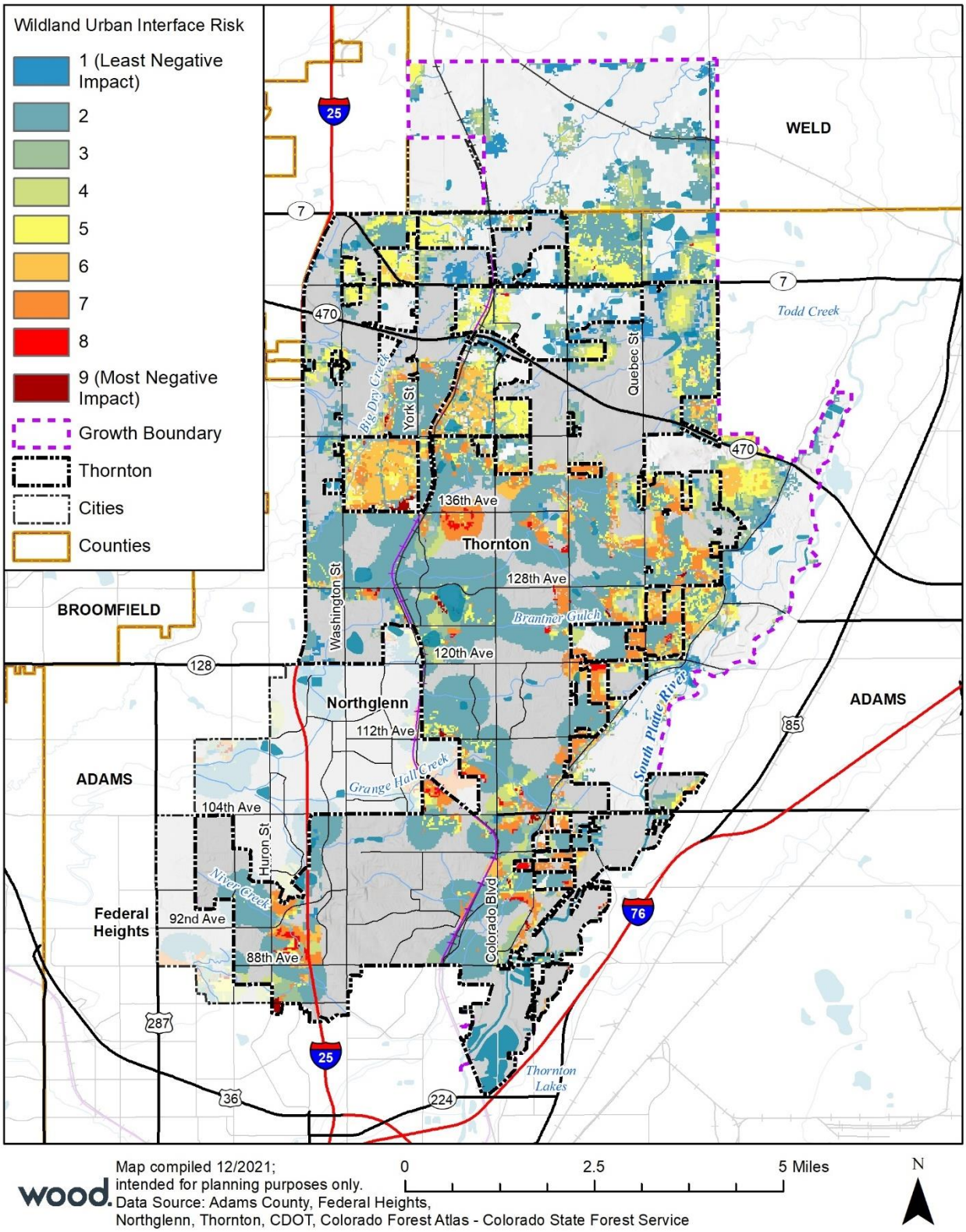
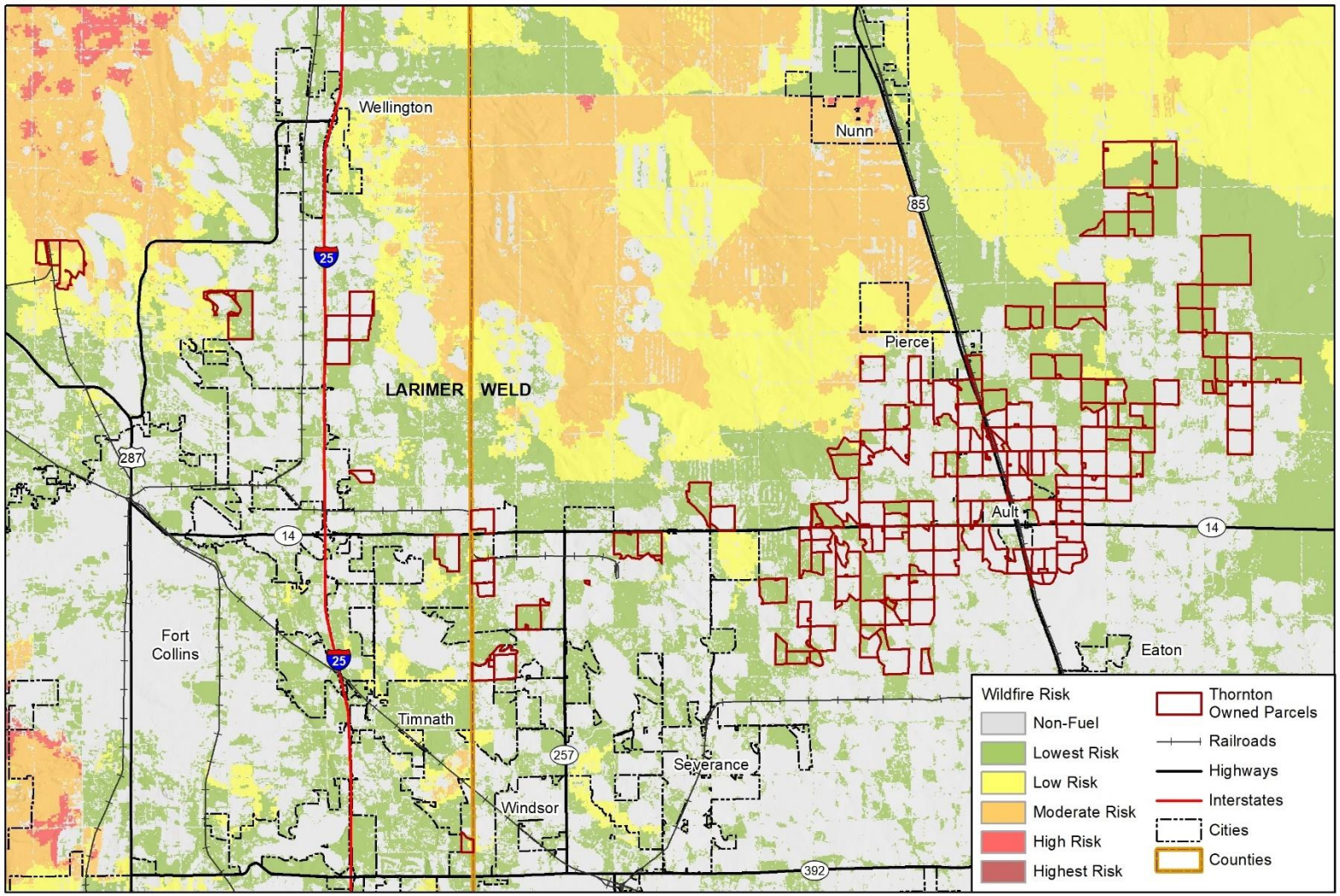
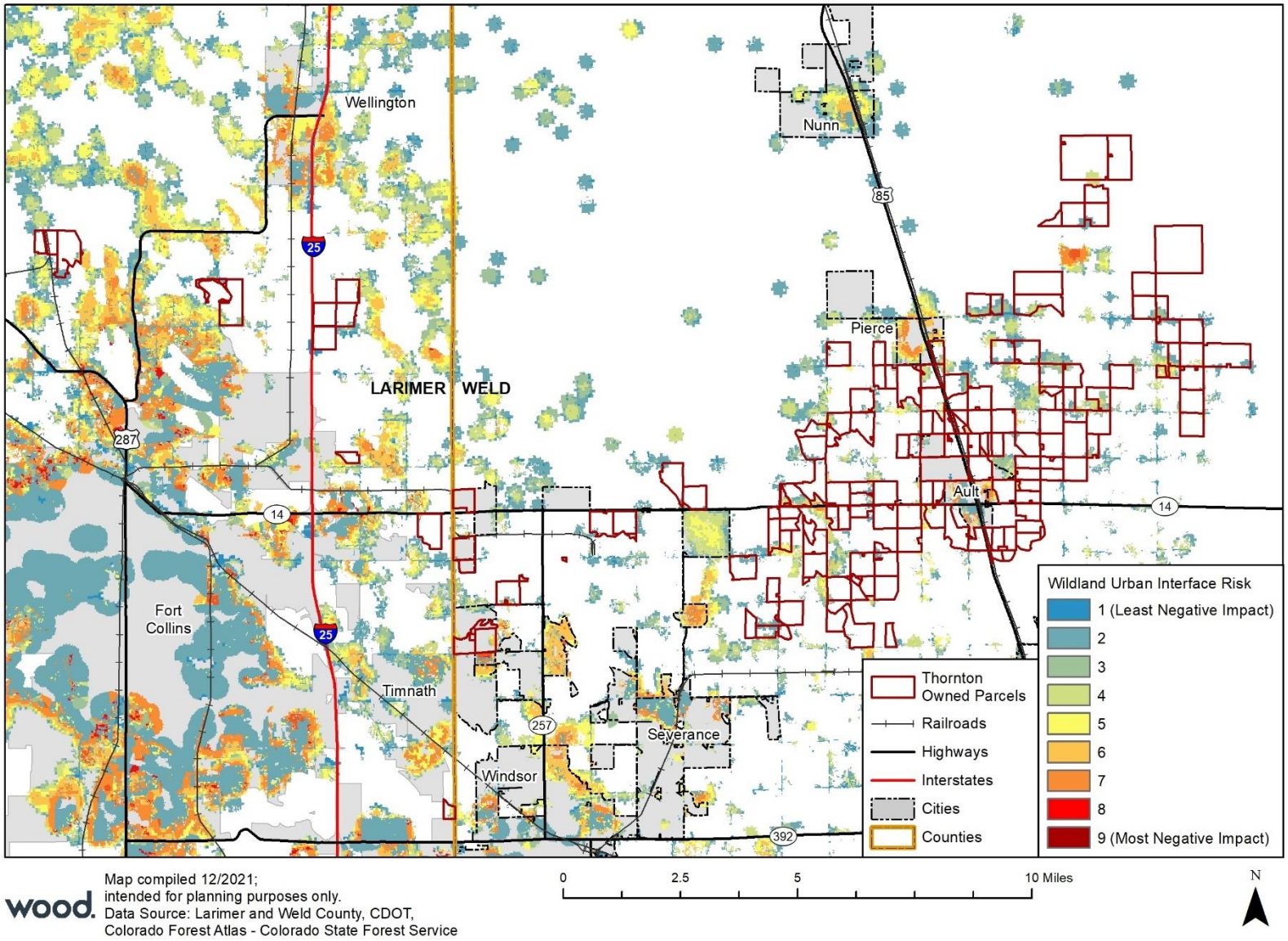


Figure A-14 Wildfire Risk to Thornton-Owned Properties in Larimer & Weld Counties



Map compiled 12/2021;
intended for planning purposes only.
Data Source: Larimer and Weld County, CDOT,
Colorado Forest Atlas - Colorado State Forest Service

Figure A-15 Wildfire Urban Interface (WUI) Areas in Thornton-Owned Properties in Larimer & Weld Counties



The city-owned properties in Larimer and Weld Counties do not have any improved parcels in wildfire risk areas. However as can be seen in Figure A-14, there is considerable wildfire risk in the areas around the parcels.

The wildfire risk to the City of Thornton is shown in Figure A-12. Figure A-13 shows the Wildland Urban Interface (WUI) areas in and near the City. Figure A-14 shows the wildfire risk to the city-owned properties in Larimer and Weld Counties, and Figure A-15 shows the Wildland Urban Interface (WUI) areas in and surrounding those properties.

A.4 Mitigation Strategy

The mitigation strategy the goals that guide Thornton's mitigation program and the specific activities the City will undertake to reduce losses from the hazards described in the HIRA. The mitigation strategy includes a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. The Thornton Planning Team followed the process detailed in Section 5 to update this strategy.

A.4.1 Mitigation Goals

Mitigation Goals are general guidelines that explain what a community wants to achieve with their local hazard mitigation plan. Thornton's Goals are overarching targets and describe the ideal long-term outcomes envisioned by the community.

- Goal 1: Protect and enhance the resiliency of people, property, critical systems, and natural resources.
- Goal 2: Improve Thornton's ability to prevent and reduce physical, economic, and societal losses from disasters
- Goal 3: Enhance Thornton's ability to recover quickly and completely from future disaster incidents
- Goal 4: Ensure that functionality of local critical facilities and systems are maintained in the event of a disaster
- Goal 5: Strengthen communication and coordination among public agencies, NGOs, businesses, and residents to better prepare for, respond to, and recover from disaster situations
- Goal 6: Increase public awareness of hazard risks, vulnerabilities, and mitigation measures & resources
- Goal 7: Integrate hazard mitigation into planning documents, budgeting processes, and other mechanisms

A.4.2 2022 Thornton Mitigation Action Plan

As discussed in Section 5, the City of Thornton had 82 mitigation actions in the 2017 Plan. The City has completed 25 of those. Another 7 actions were cancelled. See Table 5-1 in Section 5 for a list of completed and cancelled actions. The remaining 50 actions have been carried over into 2022. The City also identified 19 new actions, for a total of 69 actions.

Many of these mitigation actions are intended to reduce impacts to existing development. In addition, actions are identified to reduce impacts to future development. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations. Actions that protect critical infrastructure note which lifeline category is protected using the following abbreviations:

- COM: Communications
- ENG: Energy
- FWS: Food, Water, Sheltering
- HAZ: Hazardous Waste
- H&M: Health & Medical
- S&S: Safety & Security
- TRN: Transportation

The City's mitigation actions are listed in Table A-9 which includes information on the mitigation actions, lead and supporting agencies, estimated cost, potential funding sources, and estimated timeline.

Table A-9 City of Thornton Mitigation Action Plan

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 1	**104th & GHC South Tributary.** Reconstruct culvert and/or raise roadway east of Irma Drive intersection to provide 100-year conveyance.	Flood	T1, T2, T3; TRN	City of Thornton;	$1,000,000; City stormwater budget	2032	Medium	**Not Started.** Major Drainageway Plan for Grange Hall Creek was updated in 2018.
TH 2	**112th & Cherry Street Area.** Reconstruct/expand storm sewer system to remove homes from the floodplain.	Flood	T1, T2, T3; FWS, TRN	City of Thornton;	$800,000; City stormwater budget	2032	Medium	**In Progress.** This area is a part of the Woodglenn Masterplan update currently underway.
TH 3	**136th Ave to Washington St on Big Dry Creek.** Realign channel, grade north of channel, reconstruct Washington Street south of channel to contain 100-year flows. Remove developable properties north of the channel from the floodplain; minimize flooding on property west of the channel. See Big Dry Creek MDP – pg. 11 for reach in question.	Flood	T1, T2, T3; TRN	City of Thornton; adjacent developments	$500,000; City stormwater budget	2028	Medium	**Not started.** This project is on the stormwater fund future project priority list. It makes the most sense to complete this project along with an adjacent development project.
TH 4	**Create and Adopt Major Transportation Route Incident Response Plans.** Create and adopt an Incident Response Plan for the major traffic corridors and highways throughout the city, so that city staff can reference proper protocol when dealing with hazard events that impact those roadways. This will involve coordinate with CDOT and other jurisdictions to obtain best available data.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T7; TRN, H&M, HAZ, S&S	City of Thornton; RTD, CDOT, State Patrol, other Fire Agencies	Staff Time; City budget	2026	Medium	**Not Started.** Incident response protocols currently exist in standard operating procedures for Police and Fire however a Mass Transportation Incident Annex to the EOP has yet to be developed. Inclusion of this hazard within the HIRA will help to identify level of planning priority.
TH 5	**Installation of Advanced Metering Infrastructure.** Advanced metering infrastructure (AMI) is an integrated system of smart water meters, communications networks, and data management systems that enables two-way	Drought	T1, T2, T3, T5; FWS	City of Thornton;	$6,000,000; City of Thornton	2023	High	**In Progress.** Meters are being installed. Software is in beta testing.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	communication between utilities and customers. The system allows real-time access to water usage information at each water meter, and allows customers and Thornton to better manage water usage, detect water leaks, and operate the water distribution system. Currently, water usage is measured and recorded monthly. AMI is particularly beneficial in conservation efforts and during a drought. Usage restrictions or conservation efforts can be instantly measured, and quick actions can be taken to modify water usage.							
TH 6	**Big Dry Creek at RTD (UPRR) Railroad Embankment.** Construct engineered headwall, new pipe culvert, and additional culverts through the railroad embankment to prevent overtopping of 168th Avenue west of the railroad; west of Colorado. The additional culverts will need to be controlled by a high spillway to avoid creating downstream floods in minor, much less moderate storms, that hasn't occurred since the embankment and current culvert were constructed in 1956.	Flood	T1, T2, T3; TRN	City of Thornton; Union Pacific Railroad	$10,000,000; City stormwater budget	2033	Low	**Not Started.** This project is on the stormwater fund future project priority List, but will likely not happen until RTD North Metro Line commuter rail is extended this far.
TH 7	**Big Dry Creek Sanitary Sewer Interceptor.** Reconstruct, seal, and/or raise manholes in the railroad backwater area to prevent flood flows that pond against the embankment from overwhelming the BDC Lift station on the east side of Colorado.	Flood	T1, T2, T3; FWS, HAZ	City of Thornton	$400,000; City budget	2033	Low	**Not Started.** The Big Dry Creek interceptor is being upgraded in phases where capacity issues are identified. The segment in the railroad embankment backwater area is in an unfunded future phase.
TH 8	**Continuity of Operations Training for Local Businesses.** The project would include a public education/ training session, material	All-hazards	T1, T2, T4; COM, S&S	Economic Development and Risk Management;	$5,000; City approved budget or potential	2027	Medium	**Not Started.** New Alliance Business Center (2021) provides a direct avenue to provide local

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	development, and general assistance in the development of business continuity plans.			Neighborhood Services	mitigation grant			and new businesses with COOP related resources.
TH 9	**Colorado Blvd at Big Dry Creek.** Reconstruct Bridge on new alignment to convey 100-year flow. New alignment would also serve to remove the Colorado Boulevard/SH 7 (160th Avenue) intersection from the Morrison Creek flood plain.	Flood	T1, T2, T3; TRN	City of Thornton; MHFD	$5,000,000; City Stormwater budget	2033	Low	**Not Started.** This project is on the stormwater fund future project priority list. It is anticipated that adjacent development will be the catalyst for this project. Currently there are no plans in for review for this development.
TH 10	**Uninterrupted Communications between City Departments During Emergencies.** Determine which City facilities currently have radios, assess the appropriateness and feasibility of hardwiring, and investigate other options to ensure constant and uninterrupted communications is maintained during disaster events across City departments and buildings.	Flooding, Severe Storms, Drought, Tornado, Wildland Fire, Subsidence, Earthquake	T1, T2, T4; COM	City of Thornton	$120,000; City Budget or Regional Homeland Security Gran	2027	Medium	**Not Started;** No funding allocated. Reevaluate project relevance considering current redundant communication options.
TH 11	**Community Emergency Response Training Expansion.** The project would include funds, marketing capability, and potential part-time personnel to build upon the capability of the city CERT program.	All-hazards	T1, T2, T4; COM, FWS, H&M, S&S	Fire Department, Neighborhood Services; Police Department	$12,000; City approved budget or potential federal grants	Ongoing	High	**Annual Implementation.** Expansion of CERT Team is underway and an annual goal. Funding for program was increased in 2020 and team has grown by 9 members since 2017. As of 2022, CERT Team now consists of 20 members which included uniforms, equipment bags, quarterly trainings, annual exercises, and the FEMA - CERT Basic

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
								Course. 2023 Budget request includes $12,000 to support the CERT Team and CERT Basic Course Program.
TH 12	**Create a Crisis Communication Plan.** The city Crisis Communication Plan will be a joint information center for staff to reference so that they're educated about proper communication during and following hazard events.	Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T5, T6, T7; COM, S&S	Thornton Fire Dept., Police Dept., 911 Communications Center, Communications Office, City Manager's Office, Information Technology, Infrastructure, Community Services and City Council	Staff Time; City budget	2026	Medium	**Not Started.** Alert and Warning Plan is being developed, which includes a portion of Crisis Communications but is not specifically a Crisis Communications Plan.
TH 13	**Purchase a Mobile Command Post.** Purchase a mobile command post to be used to responding to and recovering from disasters. Plan would also have to include a warm storage area.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T5, T6, T7; COM, H&M, S&S	City of Thornton; Undetermined	$1.8 million; Homeland Security Grants	2027	Medium	**Not Started;** Project was not funded in 2021 or 2022 budget; still pursuing funding.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 14	**Create citywide debris management plan.** Creating a citywide debris management plan that will include mutual aid and cross communication between city departments.	Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T4, T6; H&M, S&S	Thornton Fire Department, Infrastructure, Communications, and Waste Management	Staff Time; City Budget	2026	Medium	**Not Started;** Currently not a planning priority.
TH 15	**Emergency Shelter.** Create Emergency Shelter facility. Provide personnel, appropriate protective clothing, and sleeping beds/cots/bags/blankets. Identify food resources.	Flood, Tornado/ Severe Wind, Wildland Fire	T1, T2, T3; FWS, H&M	Thornton Fire Department, Recreations, Thornton CERT, and American Red Cross	$15,000 - City Budget	2022	High	**In Progress;** Funds allocated in 2021 and 2022 to improve sheltering capacity. Shelter planning, training and exercise occurring in 2022.
TH 16	**Emergency Operations Center (EOC) Development Project.** The project would be the purchase via City Funds or state grants to buy equipment and technological improvements to the current conference room used as the EOC.	All-hazards	T1, T2, T3, T4; COM, FWS, HAZ, H&M, S&S, TRN	City of Thornton	$250,000; City Budget, EMPG, State Special Project Grant, or Congressional Project.	2025	High	**In Progress;** No funding allocated in 2017 through 2022. Virtual capabilities are being developed. 2022 added to Thornton CIP projects list, no definitive timeline.
TH 17	**Evaluate technology backup resources.** Evaluate all critical facility backup systems. Replace/modify any systems that need it and ensure that they will all work properly in case of hazard event. Coordinate with local cell tower owners to identify infrastructure that may need backup power.	Earthquake, Expansive Soils/ Undermined Areas, Severe Storms, Tornado/ Severe Wind, Winter Storm	T1, T2, T3; COM, FWS, S&S	City of Thornton Risk Management, Emergency and Safety Administrator; All City Departments	Undetermined; City approved budget or potential EMPG.	2025	Medium	**Annual Implementation;** IT is evaluating all department software/hardware critical infrastructure as part of the Cybersecurity Response Plan. In addition, as of 2022 all primary city buildings have back-up generators and that program is

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
								maintained by Building Maintenance.
TH 18	**Evaluate current standards and specifications for city infrastructure.** Evaluate all standards and specifications for city infrastructure. Update or revise codes to better mitigate effects of natural disasters.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T7; COM, S&S, TRN	Public Works & City Development	$150,000; City budget	2023	Medium	**Not Started**. Not budgeted, working on internal updates to checklists.
TH 19	**Evaluate lift stations exposure to flood risk.** Evaluate each lift station citywide and determine their exposure to flood risk. Develop plans to mitigate the risk at each station.	Flood	T1, T2, T3; FWS	City of Thornton	$200,000; City budget	2033	Low	**Not Started**.
TH 20	**Evaluate sewer/water crossings at roadways.** Identify all water and sewer crossings that have the potential to be exposed to scour and mitigate further degradation of crossings.	Flood	T1, T2, T3; FWS, TRN, HAZ	City of Thornton	$200,000; City budget	2033	Low	**Not Started**.
TH 21	**Expand and Improve Hazard Education for Seniors.** Specific actions that could be taken include the following: - Developing a web page or web site specific to emergency tips that would be useful to seniors. - Providing more information about services that are available to them that could help make their homes more resilient to damage that could be caused by natural disasters. - Increasing the information provided in city publications about what seniors can and should do in the event of a natural disaster. - Providing information to seniors about how to file claims for property damage, hire qualified contractors to perform disaster recovery work, and avoid scams in the wake of a natural disaster. - The city should consider GIS mapping of key areas with vulnerable populations and plan	All-hazards	T1, T2, T3, T4, T5, T6; S&S	City of Thornton; Education providers, Senior services agencies.	$1,000 for speaker fees plus additional unknown amounts for other services; City Budget, grant funds, funds from partner organizations.	2027	Low	**Not Started**.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	accordingly for assisting with disasters that may affect these areas more i.e. mobile home parks, low income housing areas, places where language could be more of a barrier.							
TH 22	**Expand the CodeRed Program.** Research funding for additional CodeRed costs. The program is currently being implemented in the city so that staff and citizens are alerted by phone/email when a hazard takes place. Additional enhancements can be made to the system, but it would require additional funds. The primary audience for this would be the citizens and as the city grows more enhancements would need to be made.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T5, T6; COM	Thornton Fire Department, Police Department, 911-Communication Center, Communications Office	$30,000; EMPG or HMA grants	Ongoing	High	**In Progress.** No funding allocated. Planning, marketing, and testing CodeRED is occurring in 2022.
TH 23	**Fire Code Updates.** Once every three years, adopt the latest edition of the International Fire Code, related codes, and appropriate local amendments.	Wildland Fire, Lightning	T1, T2, T3; S&S	City of Thornton;	$2,000 Every three years; Thornton General Fund	Every Three Years	Medium	**Annual Implementation.**
TH 24	**Fire Station Building Maintenance.** Annually, captains will inspect and evaluate stations for preventative needs. This will include checking windows and doors for security and function, ensuring all oxygen bottles and SCBA bottles within stations are secured, generators are being filled and functioning, and check stations for any other hazards. Building maintenance will ensure annual testing and inspections of generators by licensed contractors. All needs found will be forwarded as building maintenance requests go through chain of command for budgetary items.	Dam Failure; Earthquake; Expansive Soils; Flood; Water Contamination; Hazmat; Mass Transportation Incident; Public Health; Severe Cold Weather Storms; Severe Warm Weather Storms; Terrorism; Tornadoes; Wildland Fire	T3; S&S	Thornton Fire Department; Building Maintenance	Staff time; Department budget	Ongoing	High	**Annual Implementation.** Continuing support from building maintenance to maintain facilities and generators. Captains have been assigned to all six fire stations. Annual review and report generated for all City Fire Stations.
TH 25	**Fire Station Emergency Procedures.** The following response will be completed by each fire station in the event of a disaster. Stations will conduct a self-assessment to determine condition and functionality of station, equipment, and personnel. This will be reported to the	Cyber; Dam Failure; Drought Earthquake; Expansive Soils; Flood; Water Supply Contamination; Hazmat; Mass	T1; S&S	Thornton Fire Department; EOC, TPD, FVS	Staff time; Department budget	2026	High	**In Progress.** Continued work on Emergency Operations Plan, Tabletop exercises, and Training Plans. Continued work needs

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	Battalion Chief. Emergency call-back will be initiated if necessary and appropriate additional apparatus will be staffed/equipped. Crews will then initiate a windshield survey of their district with priority of assessing high value locations defined as critical infrastructure, high density populations, medical facilities, special need facilities and response support facilities. Findings will be reported to EOC. Specific hazards identified will be prioritized by EOC. Support staff will be needed to check on families of responders, respond to apparatus needs (specifically flat tires) and shuttle equipment and supplies.	Transportation Incident; Public Health; Severe Cold Weather Storms; Severe Warm Weather Storms; Terrorism; Tornadoes; Wildland Fire						to be done to complete SOPs related to post-disaster assessment and functionality. This work continues with Emergency Management and internal Fire Department working groups
TH 26	**Loss Prevention Project – Regulation Update – Flood Notification System.** The project is a priority to switch over to a more up-to-date notification system and improve our reach to the community.	Flood	T1, T2, T3, T5; COM, S&S	City of Thornton – Infrastructure, Floodplain Manager. Thornton Risk Management, Emergency and Safety Administrator; Thornton Communications Department	Staff time; City budget	2023	Medium	**In Progress.** Working on updates to Floodplain Regulations in the City Code. City updated its notification system to CodeRED in 2017.
TH 27	**Gravel Lakes Rip Rap Program.** Install rip rap on reservoir slopes.	Flood, Severe Storms	T1, T2, T3; FWS	City of Thornton;	$1,000; City of Thornton	Ongoing	High	**Annual Implementation.**
TH 28	**Hoffman Drainage.** Reconstruct culvert under 88th Avenue and improve storm sewers in Hoffman from 88th to 91st to remove homes from the mapped floodplain.	Flood	T1, T2, T3; S&S	City of Thornton; MHFD	$4,000,000; Stormwater budget	2023	High	**In Progress.** Design complete, Construction in 2023.
TH 29	**Identify local organizations that can assist with post-disaster needs.** Identify specific organizations and facilities that would be	Earthquake, Flood, Expansive Soils/ Undermined Areas,	T1, T2, T4, T5, T6; FWS,	Thornton Fire Department;	Staff Time; City Budget	Ongoing	High	**Annual Implementation.** The development and

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	beneficial for the city to utilize with in case of a natural disaster. Establishing a point of contact and possibly creating a task force committee who can work together to plan for response efforts.	Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	H&M, S&S,	All City Departments				maintenance of resources and key partner lists is an annual implementation which includes updating local vendors, connecting with faith groups and non-profits, meeting new community groups and continually expanding our stakeholders. Planning teams are developed for specific plan needs and development.
TH 30	**Implement MHFD Projects Identified.** Implement MHFD's recommended projects that identify potential mitigation projects in the North Floodplain within city limits.	Flood	T1, T2, T3; FWS, S&S	City of Thornton; MHFD	$200,000 per study; City of Thornton Stormwater and MHFD	Ongoing	High	**In Progress.** Masterplan update compiled for Basin 4100 and Niver Creek, Updates underway for Woodglen, Brantner Gulch, and Todd Creek. Future update for Big Dry Creek Tributaries (2023).
TH 31	**Lightning Detectors.** The project would be the purchase, installation, maintenance, and public education component for adding lightning detector technology at our city parks, golf course and outdoor areas.	Severe Storm	T1, T2, T4; COM, S&S	Community Services, Parks, Golf, & Recreation; Risk Management, Emergency and Safety Administrator	TBD; City approved budget or potential mitigation grant opportunities.	2025	Medium	**Not Started;** Funding not allocated.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 32	**Niver Creek Tributary M.** Replace culverts at Huron Street and 92nd Avenue with 100-year capacity culverts; channel improvements between 92nd Avenue and Huron Street for increased conveyance; new 60" storm sewer pipe in 92nd Avenue.	Flooding	T1, T2, T3; H&M, S&S	City of Thornton; MHFD	$4.1 million; City of Thornton, MHFD	2022	High	**In Progress.** Under construction, to be completed end of 2022.
TH 33	**Public Outreach Project.** The project would be become a priority for 2017 to develop a website, literature materials, and begin to build relationships in the community. In 2018 the priority would shift to improving outreach at special events, presentations, and promoting whole community planning.	All-hazards	T1, T2, T4, T5, T6, T7; S&S	Risk Management, Emergency and Safety Administrator; Neighborhood Services, Communications Department	$10,000 Annually; City approved budget or potential North Center Region grant opportunities for educational materials.	2023	Medium	**Annual Implementation;** Public Outreach is an annual effort. Public website content was developed in 2017 but will require updating, and outreach efforts are an annual effort based on available resources and events.
TH 34	**Ozone Treatment at Wes Brown Water Treatment Plant.** Install ozone treatment process and associated pump station	Drought and Flood	T1, T2, T3;	City of Thornton;	Approximately $20,000,000 for a 30 million gallons per day system; City of Thornton	2022	High	**Not Started.** Thornton is planning to treat Poudre River water at the Wes Brown WTP, which should reduce taste and odor issues. Therefore, Ozone may not be needed. There is a possibility that this plan would be implemented in the future
TH 35	**Purchase Portable Cell Towers.** Purchase portable cell towers to enhance communication and potentially create citywide wifi. Would need to coordinate with local cell tower providers. Approximately 3-4 would be needed to cover the city. Doing so would also add the need for vehicles to transport the towers.	Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T2, T3, T4, T5, T6; COM, H&M, S&S	City of Thornton; Fire Department	$250,000 per tower, approx. $1,000,000 purchase price plus storage & operational costs; City Budget, Regional Grant,	2022	Medium	**In Progress.** Partnership with Verizon is currently being established to support cell booster capability during disasters.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
					Public/Private Partnerships			
TH 36	**Reduce expansion of Emerald Ash Borer.** Prioritize affected tree removal and disposal and create a plan to mitigate further loss of vegetation to Emerald Ash Borer.	Wildfire	T1, T2, T6; S&S	Parks & Recreation	TBD; City of Thornton	2030	High	**In Progress.** The forestry district maintenance plan continues. Ongoing removal of poor condition ash trees that are more susceptible hosts to EAB. Contractor has treated healthy good condition ash trees to help prevent infection.
TH 37	**Bring commercial buildings out of the floodway.** Develop a plan to coordinate with local commercial building owners to relocate businesses out of the floodway.	Flood	T1, T2, T4, T5, T6; S&S	Economic Development	TBD; City of Thornton	2030	Medium	**In Progress.** Current City Code allows non-residential buildings to remain, even be built, on lots within the mapped floodplain. New construction in the floodway would be prohibited without a "no rise" certification.
TH 38	**School Tributary.** Railroad/Old Welby Road to Monroe Street; Phase 1, Catalina Apartments driveway to west of Monroe Street being jointly funded Thornton and MHFD.	Flood	T1, T2, T3; S&S	City of Thornton; TBD	$4,000,000; City Stormwater and MHFD	2032	Medium	**In Progress.** The drainage pipeline between the Catalina Apartments and Monroe St has been completed.
TH 39	**Stockpiling Emergency Shelters.** Creating stockpiles in each of the city's emergency shelters. This could include water, heat blankets, education materials, food, etc. Staffing would also need to be planned out. An added layer to this would be to identify additional areas to add as emergency shelters.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T4, T5; FWS, S&S	City of Thornton; TBD	$500,000; City Budget	2022-2027	High	**In Progress.** In 2022, funding was allocated to improve city shelter trailer, Shelter staff and volunteer list was updated, Shelter Ops training was offered, Mass Care/ Shelter Plan

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
								and forms are being updated, and a full-scale exercise is in the planning phase.
TH 40	**Stockpiling Fire Stations.** All stations shall be inspected and evaluated for alternative staffing and uses in the event of a disaster. Stations will be measured for sleeping space and staffing of extra apparatus. Station 5 shall be evaluated as alternative EOC and/or dispatch site. Station 5 also houses Emergency Management trailer with extra cots and bedding.	Disasters requiring special attention	T2; FWS, S&S	Thornton Fire Department; Emergency Manager	$30,000 - City Budget	2027	Medium	**Not Started**
TH 41	**Tertiary Data Center Location.** The project would focus on identifying a new data center location, as well as resources to house there. An option could be "cloud" based, which would provide access from anywhere, but would require a significant shift in ownership and housing of City data. Internet services would be validated and enhanced to provide multiple connections and replication of City data. Services would need to be ordered to facilitate the new server and storage needs, as well as testing to validate connectivity.	All-hazards	T2, T3; COM, S&S	City of Thornton - IT Department; City of Thornton - All Departments	Not determined at this time; City Budget Process or grant funding	2026	High	**Not Started;** Pandemic budget cuts have kept this off the radar for completion.
TH 42	**Thornton as Emergency Transportation Provider for Seniors.** Identify and organize city staff and city vehicles, and/or work to mobilize volunteers within the community to provide necessary transportation for seniors in emergency situations to access required medicines, medical treatments, food, or other necessary services, equipment, or provisions.	All-hazards	T1, T2, T3, T4, T5; FWS, H&M, TRN	City Emergency Management, Recreation, Active Adult, Innovage, RTD, Adams 12 & 27J Schools	TBD; City Budget	Ongoing	Medium	**Not Started.** Thornton partners with RTD & School District Bus Services to move residents during natural disasters.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 43	**Thornton Facilities as Temporary Shelter for Seniors.** Maintain and enhance the city of Thornton's ability and capacity to provide emergency shelter for senior citizens whose homes have been damaged by one or more natural hazards. Such improvements may include maintaining and improving relationships with the Red Cross and other organizations.	All-hazards	T1, T2, T3, T4, T5; FWS	City of Thornton; Red Cross	TBD; City of Thornton, Adams County; Local commercial and manufacturing businesses.	Ongoing	Medium	**In Progress.** Thornton combines seniors into the general sheltering plan for all residents during a natural disaster. Emergency Services does have supplies to support the needs of the senior pop should an emergency shelter situation occur. Still a work in progress but the city sheltering plan will address seniors.
TH 44	**Community Tornado Shelters.** The project would include the building and training of local manufactured home communities to use and maintain local tornado shelters.	Tornados and Severe Storms	T1, T2, T4; COM, FWS, S&S	City Development and Neighborhood Services; Risk Management	$2,000,000; City approved budget, potential mitigation grant, or community development block grant/funding opportunities.	2030	Low	**Not Started.** No funding allocated and not prioritized.
TH 45	**Utilize Local Organizations for Messaging.** Work with local organizations like Community Faith United to notify community members about hazards. These orgs are a great outlet for distributing news and resources. They are great places to utilize message for post disaster events and to increase people's awareness about local hazards.	Drought, Earthquake, Flood, Expansive Soils/ Undermined Areas, Severe Storms, Public Health Hazards, Tornado/ Severe Wind, Winter Storm, Wildland Fire	T1, T4, T5; COM	Thornton Emergency Management	Staff time; City Budget	2026	Medium	**Annual Implementation;** Emergency Management is annually working with community organizations and networks to share preparedness information and build partnerships.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 46	**Washington St and GHC South Tributary.** Reconstruct culvert to convey 100-year storm – may require lowering the Denver Water - Broomfield water main.	Flood	T1, T2, T3; FWS	City of Thornton, MHFD	$2,500,000; Stormwater	2023-2026	High	**Not Started.** Design planned to start 2023, construction 2025 in the Stormwater Utility fund plan.
TH 47	**York St & Big Dry Creek, E-479 to York.** Replace bridge to handle 100-year flows, eliminate overtopping. Realign channel upstream of York to improve hydraulic efficiency (see "map" page 14 in the Tiff directory)	Flood	T1, T2, T3; S&S, TRN	City of Thornton	$6,000,000; Gov Cap and Stormwater	2023	High	**In Progress.** In design, construction in 2023
TH 48	**Hazardous Tree Mitigation.** Develop and implement a plan to conduct a city-wide assessment of trees located on public lands and rights of way to determine and catalog the status of their health and if the potential of falling branches or entire trees pose a threat to people and improvements in the area. Implement actions to remove dangerous limbs and dead, sick, or dying trees to reduce the threat that they pose.	Severe Storms, Tornados and Severe Winds, Winter Storms, Floods	T1, T2; S&S	City of Thornton;	TBD; City of Thornton	2027	Low	**In Progress.** ID and removal of 30 hazardous trees across the City. Pruning of various trees to prevent hazardous conditions from occurring.
TH 49	**Address Risks Associated with Climate Change.** The Colorado Climate Change Vulnerability Study produced by the University of Colorado and Colorado State University provides 35 recommendations divided into four categories: assessing, planning and managing for resilience; developing and sharing information; public engagement; and building capacity.	Drought, Extreme Temperatures, Flood, Severe Storms, Public Health Hazards, Winter Storm, Wildland Fire	T1, T2, T3; COM, ENG, FWS, H&M, S&S, TRN	City of Thornton; Tri-County Health Department	Staff time; City budget	2025	High	**Not Started**
TH 50	**Flood Threat Assessment & Flood Risk Communication (Website development).** Inventory public assets at risk from flooding and categorize the corresponding risk. Develop an interactive public website tailored to each jurisdiction to educate people about flood risks and specific actions they can take to keep safe	Flooding	T1, T2, T3, T5, T6; COM, FWS, S&S, TRN	City of Thornton; MHFD	$50,000; City of Thornton, City of Northglenn, City of Federal Heights, MHFD, CWCB, FEMA	2026	Medium	**Not Started**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	during dangerous conditions and minimize flood-related losses.							
TH 51	**Grange Hall Creek - 104th Tributary, east of Birch St.** The flume carrying the 104th Avenue Tributary over the Colorado Agricultural Canal has adequate capacity for the 100-year event. Floodwaters may, however, overtop the channel and threaten residential structures in the area due to a poorly defined channel upstream. It is proposed that the earth berm west of the canal be raised 2 feet to ensure that floodwaters are successfully funneled to the flume. This would prevent floodwaters from overtopping the canal and threatening residential buildings.	Flooding;	T1; FWS	City of Thornton - Infrastructure; MHFD	$10,000 - $100,000; City Budget	2022-2023	Medium	**New in 2022**
TH 52	**Niver Creek Tributary M - Thornton Parkway to E. Balsam Dr.** Increase storm system capacity to remove 22 residential structures from the floodplain.	Flooding;	T1; FWS	City of Thornton; MHFD	More than $1,000,000; Capital Improvement Plan	2025	Medium	**New in 2022**
TH 53	**Niver Creek at 96th Ave.** Replace existing 78" CPM with dual 8'x5' RCBC. Remove 7 residential structures from the floodplain, current culvert does not have capacity for 100-year flows.	Flooding;	T1; FWS	City of Thornton; MHFD	$100,000 - $1,000,000; Capital Improvement Plan	2025	Medium	**New in 2022**
TH 54	**Niver Tributary N at Huron St.** This project would replace the existing crossing with dual 8' x 8' RCBC at Huron St for the 100-yr event and replace concrete channel from Huron St to Thornton Parkway with grass lined channel, including drop structures. This work is as identified in the Urban Drainage Niver Creek Major Drainageways plan.	Flooding;	T1; TRN	City of Thornton; MHFD	More than $1,000,000; Capital Improvement Plan	2028	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 55	**Niver Creek crossing at Grant St and 84th Ave.** Increase storm sewer capacity for 100-year flows. Remove Grant Street and 84th Ave from floodplain.	Flooding;	T1; TRN	City of Thornton; MHFD	$100,000 - $1,000,000; Capital Improvement Plan	2030	Medium	**New in 2022**
TH 56	**Basin 4100 Outfall Improvements.** Construct a defined channel and berm east of Colorado Blvd, replace existing culverts at Old Riverdale Road, and construct a defined channel with drop structure to SPR.	Flooding;	T1; TRN	City of Thornton; MHFD	More than $1,000,000; Capital Improvement Plan	2029	Medium	**New in 2022**
TH 57	**Infrastructure for water reuse.** The city should plan to add the technology to reuse water that is discharged from households. This would mitigate the effects of drought, effectively adding a new water supply for the city. It would also mitigate the long-term effects of global warming which is drying out the South Platte River Basin. Even if precipitation remains the same the basin will dry more due to a longer growing season and greater evaporation due to higher temperatures. The reused water could also be used to increase the health of the city's tree canopy and expand it.	Drought/ Excessive Heat;	T1, T2, T3, T7; S&S, FWS, H&M	Thornton Water; Infrastructure	Unknown; FEMA HMA Grants	2024	Medium	**New in 2022**
TH 58	**Infrastructure and technology for rationing water.** The Thornton Drought Management Plan cites water rationing as one of two measures the city can take if there is an extreme disruption to water supplies. (The other is a drought surcharge that is contained in the recent rate ordinance.) The plan anticipates that this would be caused by a multiple-year drought and the resulting low streamflow. Thornton relies on diversions of surface water from the South Platte River and Clear Creek to replenish storage volumes for treatment and distribution to residents, businesses, and other entities such as the Adams 12 School District. Currently there is no plan in	Drought/ Excessive Heat; Public Health Hazards; Water Supply Contamination;	T1, T2, T3, T6, T7; FWS, H&M	Thornton Water; Infrastructure	Unknown; FEMA HMA Grants	2024	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	place because the infrastructure necessary for rationing does not exist is the city's system. Thornton is also building a pipeline for water supply from the Cache la Poudre River which will also depend on streamflow. Implementing rationing infrastructure prior to a crisis is imperative.							
TH 59	**Installation of solar energy to boost the move to renewable energy and lessen evaporation from Thornton's facilities.** Thornton can move quickly to embrace renewable energy and meet its goals under the Energy Action Plan with Xcel by installing solar PV on reservoirs and irrigation ditches. This would reduce evaporation from city facilities and would bolster the city's raw water supplies. Evaporation from reservoirs currently takes around 5,000 acre-feet (1.6 billion gallons) out of the raw water supply annually. Longer-term this strategy would help to mitigate the effects on global warming.	Drought/Excessive Heat;	T1, T2, T4; FWS, H&M, ENG	Thornton Water; Infrastructure	Unknown; FEMA HMA Grants	2024	Medium	**New in 2022**
TH 60	**Multifactor Authentication.** Require Multifactor Authentication to gain access to city and SCADA networks. require enhanced password requirements and frequent password changes, set antivirus and antimalware programs to conduct regular scans, enable strong SPAM filters to prevent phishing emails from reaching end user, update software and patches, filter network traffic. assign to Cybersecurity Analyst in IT.	Cyber Security Attack;	T1; S&S, FWS, H&M, COM	IT; Infrastructure	$10,000 - $100,000; City Budget	2021-2024	High	**New in 2022**
TH 61	**Topographical study, analysis, and implementation of natural snow fencing or other snow drift mitigation throughout Thornton.** Historically, Thornton experiences significant snow drifts during major winter storms that block roadways, strand motorists, decrease emergency response times or create	Severe Cold-Weather Storms;	T1, T2, T6, T7; S&S, H&M, TRN	Thornton Fire Department - Emergency Management; City Planning, Infrastructure,	$100,000 - $1,000,000; FEMA HMA Grants	2024	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	scenarios where responders cannot get apparatus, and are resource heavy to address for plowing and road closure impacting the maintenance of the rest of the City. The goal would be to determine optimal locations in the City where snow drifts and access issues occur, determine funding opportunities, solidify funding, and deploy earthen berms, natural snow fencing, and/or other methods that decrease snow impacts on city roadways.			Forestry, and GIS				
TH 62	**Fuels management strategy and proscribed burns in open space areas to reduce wildland fire risks.** The Marshall Fire, Black Forest Fire, and Thornton Quebec & 136th Fire have shown that wildland fire risk is not only limited to the Wildland Urban Interface in the Foothills. Open spaces when left unmanaged can cause fuel loads to build up and when combined with favorable weather conditions could lead to an uncontrolled wildland fire threatening any Thornton neighborhood with its proximity. In addition, with the environmentally and drought friendly landscaping initiatives the City is implementing, the need for fuel managements in our open spaces and anywhere native vegetation is reintroduced grows. This project would include a Wildland Fire management strategy, policy, plan, and schedule to be developed within the appropriate city departments and external agencies. As well as the actual live burning of high-risk open spaces on an appropriate rotational schedule.	Wildland Fire;	T1, T2, T6, T7; S&S	Thornton Fire Department - Emergency Management; Parks and Recreation, City Manager's Office, Communications, Infrastructure, Adams County SO, State DFPC, and more	$100,000 - $1,000,000; State Grants	2024	High	**New in 2022**
TH 63	**Air Quality Monitoring.** This project would include the planning and deployment of stationary air quality monitors throughout the city to monitor air quality for	Hazardous Materials;	T1, T2, T5, T6; HAZ	Thornton Fire Department - Emergency Management;	More than $1,000,000; Other	2025	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	public/environmental health, EPA reporting, but especially to provide a quality measuring along I-25, US-85, Commerce City and E-470, to assist with tracking fallout from major hazmat spill in the city.			Infrastructure, City Planning, City Manager's Office, and Adams County LEPC				
TH 64	**Weather Stations at City Buildings.** The project would include partnering with the NWS to put weather station monitor on key city buildings to improve data sharing with the NWS, improve forecasting, and weather conditions monitoring during weather related events.	Drought/ Excessive Heat; Flooding; Severe Cold-Weather Storms; Severe Warm-Weather Storms; Tornado/ Microbursts;	T1, T2, T5, T6; S&S, COM	Thornton Fire Department - Emergency Management; Building Maintenance, Management Services, Infrastructure, and National Weather Service	$100,000 - $1,000,000; Other	2024-2026	Medium	**New in 2022**
TH 65	**Cyber Security Response Plan.** This project is to develop a Cyber Security Response Plan as part of the City's EOP structure, that addresses prevention strategies, roles and responsibilities, authorities, damage assessment, response procedures, investigations, and more for a cybersecurity incident.	Cyber Security Attack;	T1, T2, T3, T4, T7; S&S, COM	Thornton Management Services - Information Technology; Thornton Police Department, City Manager's Office, Communications, & external agencies as needed.	$10,000 - $100,000; City Budget	2022-2024	High	**New in 2022**
TH 66	**Vehicle Borne Attack Prevention at Margaret Carpenter Recreation Center.** Annually the City hosts its largest public events, Winterfest, Thorntonfest and July 4th Fireworks, at the	Terrorism/Active Shooter;	T1, T2, T4, T5, T6; S&S, TRN	Thornton Fire Department - Emergency Management;	$10,000 - $100,000; Other	2024-2025	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
	Margaret Carpenter Recreation Center fields drawing crowds of 10,000 up to 60,000 with both driving and walking pedestrians. In 2018 a Threat and Risk Assessment of the facility by the Dept. of Homeland Security, identified vehicle borne attack as a potential danger for the events on the field from Colorado Blvd. This project would include determining funding and deployment of natural features (i,e, earthen mounds or boulders) along the field to reduce risk for accidental or intention vehicle borne threats to the public at special events.			Thornton Police Department, Parks and Recreation, Infrastructure				
TH 67	**Hazard Mitigation in other City Plans.** Incorporate the concepts of hazard mitigation planning in the development, amending, and updating of other city planning documents.	Cyber Security Attack; Dam/ Levee Failure; Drought/ Excessive Heat; Earthquakes; Expansive Soils/ Undermined Areas; Flooding; Water Supply Contamination; Hazardous Materials; Mass Transportation Incident; Public Health Hazards; Severe Cold-Weather Storms; Severe Warm-Weather Storms; Terrorism/Active Shooter; Tornado/ Microbursts; Wildland Fire	T1, T2, T3, T4, T5, T6, T7; HAZ, TRN, COM, ENG, H&M, FWS, S&S	Thornton City Development, Policy Planning and/or other Departments & Divisions as appropriate	Unknown; City Budget	Continuous	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status & Implementation Notes
TH 68	**Hazard Planning in the Development Code.** The City of Thornton is undertaking a major update of its Development Code that will include many substantive changes to the city's regulations for land use and development. As one part of this update, the City will work with consultants to evaluate and propose changes or new standards that could address aspects of hazard mitigation. If adopted, having codified regulations would strengthen the city's resiliency against hazards.	Drought/ Excessive Heat; Flooding;	T1, T7; S&S, FWS, TRN	Thornton City Development Department;	Unknown; City Budget	2022-2024	Medium	**New in 2022**
TH 69	**Building Code Updates.** Complete an update to the building codes every three years.	Dam/Levee Failure; Drought; Earthquakes; Expansive Soils; Flooding; Water Supply Contamination; Hazmat; Mass Transportation Incident; Public Health Hazards; Severe Cold-Weather Storms; Severe Warm-Weather Storms; Terrorism; Tornado/ Microbursts; Wildland Fire;	T1, T2, T3, T4; S&S, FWS, H&M, ENG, TRN, COM, HAZ	Thornton City Development; None	$10,000 - $100,000; City Budget	2022 & 2025	High	**New in 2022**

A.5 Implementation and Maintenance

The City of Thornton will follow the Implementation and Maintenance procedures spelled out in Section 6. The City Emergency Manager will be responsible for the monitoring, evaluating, and monitoring the Plan as detailed in Section 6.2.

A.5.1 Implementation and Maintenance of the 2017 Plan

Since the approval of the 2017 Plan, the Thornton Planning Team met ___ times. Status of mitigation projects were generally tracked by their lead agencies and status updates were communicated to the HMPC as needed.

A.5.2 Incorporation Into Existing Planning Mechanisms

The City of Thornton will seek to incorporate the information in this Plan into other city plans and processes wherever possible, as described in Section 6.3. Specific actions the city will take include:

- Expand stakeholders in hazard mitigation.
- Committee members participate in other planning processes.

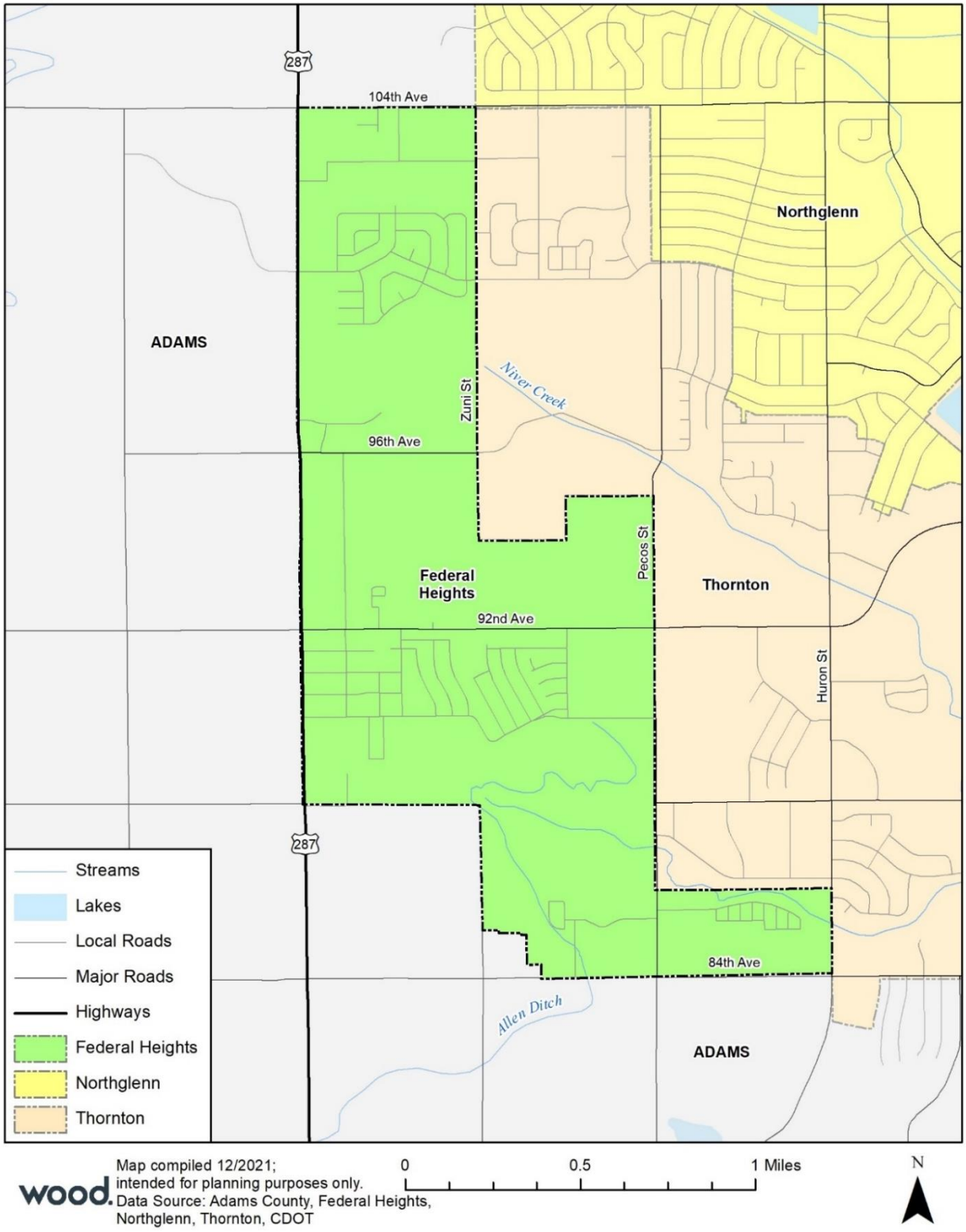
A.5.3 Continued Public Involvement

The City of Thornton will make every effort to keep the public informaed and engaged in hazard mitigation, as described in Section 6.4. Specific actions the city will take include:

- Update website with HMP annual update information
- Continue to promote public education of hazards identified in the HMP

B. The City of Federal Heights

Figure B-1 The City of Federal Heights



B.1 Introduction

This Annex was updated as part of the 2022 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan update process. The City of Federal Heights fully participated in the 2022 update process as described in Section 2, to include:

- Participating in the Hazard Mitigation Planning Committee (HMPC)
- Coordinating between different city departments/agencies and stakeholders
- Updating jurisdictional information
- Identifying new mitigation actions
- Coordinating formal adoption

The City had previously participated in the 2017 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan and has been active in implementing that plan as described in Section B.5. A review of jurisdictional priorities found no significant changes in priorities since the last update.

B.2 Community Profile

The City of Federal Heights is located within Adams County, which is one of the more densely populated counties in the state. Federal Heights lies just northwest of Denver and is along Interstate 25, which lies to the east of the city. Federal Heights only encompasses approximately 1.8 square miles of total land area but ranks second statewide in density with approximately 8,099 persons per square mile. The city's urban extent has not changed since 2000 and is not expected to grow between 2006 and 2035.

B.2.1 History

Several historic events were highlighted as catalysts to the formation of the City of Federal Heights. The first was the establishment of the General Land Office in 1812 that created land policy and facilitated millions of people in the United States to gain ownership of land. Then in 1862, President Abraham Lincoln signed the Homestead Act that allowed settlers to obtain up to 160 acres of land with no cost. This allowed people like Albert E. Johnson, who purchased the plot of land that would later become the City of Federal Heights, to acquire land. Johnson sectioned out his 160-acre plot of land into 55 tracts and in 1940, 38 landowners living in the area signed a petition to incorporate Federal Heights. The petition worked, and the City of Federal Heights was officially incorporated in 1940.

B.2.2 Demographics

The City of Federal Heights is comprised of a diverse array of household types. During the 1970s and 1980s, Federal Heights grew at a significantly higher rate than adjacent communities, due primarily to the outward expansion of the Denver Metropolitan Area and annexation of several mobile home parks. This trend has continued, with the City growing by 18% since 2010.

Federal Heights is a young city with a median age of 29.6; 11.2% of the City's population is under 5 years of age (compared to 5.8% for Colorado as a whole) and those under 18 years of age make up 31.6% of Federal heights (compared to 22.1% for the state). The City also has a significantly higher Hispanic/Latino population compared to the rest of the planning area and the state. Almost half of City residents speak a language other than English at home. The percentage of people living in poverty and people without health insurance are both more than twice the average for Colorado as a whole.

Table B-1 Federal Heights Demographic and Social Characteristics

	Federal Heights	Colorado	U.S.
Population	15,537	5,773,714	331,449,281
% Growth since 2010	18%	15%	7%

	Federal Heights	Colorado	U.S.
Median Age	29.6	36.7	38.1
Housing Occupancy Rate	94.3%	90.0%	87.9%
% of Housing Units with no Vehicles Available	4.7%	5.1%	8.6%
Median Home Value	$71,700	$343,300	$217,500
Unemployment	4.7%	3.9 %	4.0%
Mean Travel Time to Work (minutes)	28.1	25.8	26.9
Median Household Income	$49,291	$72,331	$62,843
Per Capita Income	$22,703	$38,226	$34,103
% of Individuals Below Poverty Level	21.2%	10.3%	13.4%
% Without Health Insurance	21.3%	7.6%	5.1%
Average Household Size	3.14	2.56	2.62
Households with a broadband internet subscription	82.5%	89.6%	85.2%
% of Population Over 25 with High School Diploma or Higher	69.4%	91.7%	88.0%
% of Population Over 25 with bachelor's degree or Higher	12.2%	40.9%	32.1%
% with Disability	7.5%	10.6%	12.6%
Language other than English spoken at home	49.8%	16.4%	21.5 %
% Foreign born persons	25.7%	9.5%	13.5%

Source: U.S. Census Bureau, American Community Survey

Table B-2 Federal Heights Demographics by Race and Sex

	Federal Heights	%
Total Population	13,537	-
Male	6,814	50.3%
Female	6,723	49.7%
Hispanic or Latino	8,782	64.9%
White, not Hispanic	4,411	32.6%
Asian	143	1.1%
Black	42	0.3%
American Indian and Alaska Native	44	0.3%
Native Hawaiian/Pacific Islander	0	0.0%
Some other race	12	0.1%
Two or more races	103	0.8%

Source: U.S. Census Bureau, American Community Survey

B.2.3 Housing

Federal Heights is made up of a variety of dwelling types. Mobile homes comprise 46% of housing units in the City, compared to less than 4% statewide; this is reflected in the City's low median home value of only $71,700. Apartment buildings with 10 or more units make up 22.5% of housing units, again significantly higher than the state's average. Single-unit homes make up only 22.2% of housing, compared to 71.3% statewide.

B.2.4 Economy

The largest industries in Federal Heights are Construction (19%), Arts, entertainment, and recreation, and accommodation and food services (16%), and the Retail trade (11%).

Table B-3 Distribution of Industry Type by City

	Federal Heights
Full-time, year-round civilian employed population 16 years and over	4,290
Construction	798
Arts, entertainment, and recreation, and accommodation and food services	672
Retail trade	468
Educational services, and health care and social assistance	467
Manufacturing	442
Professional, scientific, and management, and administrative and waste management services	396
Finance and insurance, and real estate and rental and leasing	317
Other services, except public administration	215
Agriculture, forestry, fishing and hunting, and mining:	150
Transportation and warehousing, and utilities:	115
Wholesale trade	100
Public administration	86
Information	64

Source: United States Census Bureau

B.2.5 Social Vulnerability

As discussed in Section 3.6 of the base plan, social vulnerability in the City of Federal Heights is significantly high compared to the rest of the planning area and the state, ranking above average or high in all categories.

A closer look at the distribution of individual social vulnerability indicators within Federal Heights will give local emergency managers, planners, and stakeholders an even clearer picture of where resources should be prioritized in order to reduce vulnerability in the community. It should be noted that even though the city may have relatively fewer people in a SVI category compared to the state, there are still people in that category who may be disproportionately impacted by disasters. Over time, Federal Heights should continue to monitor their social vulnerability as demographic, economic, and housing related conditions change.

B.2.6 Future Development

Adams County as a whole is expected to continue growing, reaching an estimated 800,000 residents by 2050 according to the Colorado State Demography Office. The City of Federal Heights is not expected to increase its urbanized area by 2035, therefore significant population growth is not expected. The City has very little vacant, residentially zoned land available for future development and is already very dense. There is a possibility that redevelopment of existing mobile home parks could take place, which would emphasize mixed-use commercial/residential development.

Federal Heights will incorporate information from this HMP update to inform strategic decision making. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan

B.2.7 Capability Assessment

Federal Heights has numerous existing regulatory and planning mechanisms in place that support hazard mitigation planning efforts. These tools include a comprehensive plan, an economic development plan, and local zoning regulations.

Federal Heights is a participant in the National Flood Insurance Program (NFIP). Since it entered the program, the city has adopted the minimum NFIP requirements into its Charter and City Code and Ordinances. Given the flood hazard and risk in the City of Federal Heights and recognizing the importance of the NFIP in mitigating flood losses, an emphasis is placed on continued compliance with the NFIP. 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 and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance.

City of Federal Heights Comprehensive Plan (1997)

A primary objective of the Federal Heights Comprehensive Plan is to guide development toward an economically sustainable environment which can generate the revenues necessary to provide all the services required by the residents to sustain a high quality of life. The pursuit of this quest will result in revitalized commercial areas. Other significant objectives are to improve the visual quality of commercial areas and neighborhoods; facilitate and support a strong sense of community, enhance conditions necessary to a healthy and safe environment and to protect tax-payers investment in public services and infrastructure. This Plan sets forth a comprehensive view of the community relating to development by describing the existing conditions, establishing goals for desirable future conditions, and describing potential strategies by which to achieve the stated goals.

Federal Heights Municipal Code of Ordinance

The Federal Heights Municipal Code of Ordinance is a collection of laws passed by the local government. The Federal Heights Code of Ordinance features various chapters related to hazard mitigation, including those listed below.

- **Emergency Services**: This section describes the procedures related to alarm systems and fire alarm systems to warn people in the community of a hazard.
- **Environment**: The intent of this section is to regulate non-stormwater discharges to the storm drainage system and subsequent receiving waters as required by federal and state law to protect and enhance the water quality of the city's watercourses, water bodies, and wetlands in a manner consistent with the federal clean water act.
- **Flood**: The flood hazard areas of the city are subject to periodic inundation, which can result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the health, safety, and general welfare of the public. Flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.
- **Traffic and Vehicles**: Officers of the police department, or such special officers as are assigned by the chief of police, are hereby authorized to direct all traffic by voice, hand or signal in conformance with State traffic laws and this code; provided that, in the event of fire or emergency, or to expedite traffic or protect pedestrians.
- **Utilities**: It is the intent of the city council to protect the city's potable water distribution system from contamination or pollution by backflow from an owner's internal distribution system or private water system, and to provide for the maintenance of a continuing program of cross-connection control, which will systematically prevent the contamination or pollution of the city's potable water distribution system.
- **Zoning**: The provisions of this chapter shall be regarded as the minimum requirements for the protection of the public health, safety, and general welfare. This chapter shall be regarded as remedial and shall be liberally construed to further its underlying purposes.

Fire Department

The Federal Heights Fire Department provides professional, compassionate public safety services and fire prevention and educational activities throughout the community. The department responds to over 2,500 emergency calls per year, 80 percent of which are emergency medical calls. The remaining 20 percent vary but include house fires, children locked in cars, and hazardous spills. The fire department's fire prevention activities include commercial fire safety inspections, plan review, permitting, school visits, safety demonstrations, smoke detector installation, station tours, child car seat safety installations, and a resident and business lock box program. A Fire Captain also serves as the lead for the city's Emergency Management.

Police Department

The mission of the Federal Heights Police Department is to establish and maintain an ongoing partnership with the citizens of the community that promotes, preserves, and delivers a presence of security, safety, and quality services. The police department fulfills this mission with courtesy, integrity, and respect.

Department of Planning and Zoning

The Planning Department is primarily responsible for the coordination and approval process for all proposed land development. The department tracks statistical information such as population estimates and other relevant demographic information. Planning staff also perform inspections and enforce zoning regulations, and site development plans in addition to processing general zoning requests.

Public Safety Communications

A key component of the public safety communications is the use of Code RED. Code RED is a reverse 911 system that is used in the Adams County to send information to the public. Examples of information send with Code RED include evacuation notices, bio-terrorism alerts, boil water notices, severe weather, and missing child reports. Other communication sources include social media outlets such as Facebook and Twitter.

Public Works Department

The City of Federal Heights Public Works Department is responsible for the maintenance of the city roads, buildings, signs, wet utilities, and parks. This includes mowing, tree trimming, building maintenance, street sweeping, snow removal and regular maintenance of water, sewer, and storm water systems. There are over 44 lane miles of roads to maintain in Federal Heights in addition to 24 miles of water lines, 18 miles of sewer and 4 miles of storm water lines.

Housing and Community Services

In 2013, the City of Federal Heights City Council adopted Municipal Ordinance 13-02 requiring all residential rental properties within the city to be registered and inspected for safe, healthy, and habitable housing. The City obtained a Community Development Block Grant through Adams County for the administration of this program that covers costs without registration or initial inspection fees. The City's rental inspection ordinance applies to all types of residential units including apartments, houses, and mobile/manufactured homes including properties under a lease/purchase and/or a rent-to-own contract and requires all rental units to be registered annually.

The purpose of these inspections is to identify and correct basic interior and exterior safety and maintenance issues as required by the 2012 International Property Maintenance Code, adopted by the City and issued by the International Code Council. The Rental Housing Inspector schedules systematic inspections with property owners on all rental units at least once every four years.

Opportunities for Improvement

While the City has a number of strong capabilities that can be used to support mitigation, there are several areas where those capabilities could be enhanced or improved. Additional training on mitigation for key city staff would help strengthen existing mitigation capabilities and programs. The City could develop Continuity of Operations (COOP) and Continuity of Government (COG) Plans to ensure city government is able to continue to deliver critical services during a disaster or other interruption. The City could also look at building its capability to plan for hazard reduction, resiliency, and transportation, possibly in coordination with the other cities or Adams County. The City could also consider joining the Community Rating System (CRS), although the City's limited number of flood insurance policies may make that not worth the time and resources required.

As part of the ongoing effort to mitigate hazards before disasters occur the City of Federal Heights will continue to evaluate and prioritize ongoing capital expenditures with priority given to projects that address the vulnerabilities and hazards identified in this plan.

B.3 Hazard Identification and Risk Assessment

This section supplements Section 4 of the Base Plan by providing a refined vulnerability assessment specific to the City of Federal Heights for those hazards where the risk is significantly different from that of the planning area overall, or where sufficient data exists to conduct mapping and analysis at the municipal level. The risk for each hazard may vary slightly between the three cities due to specific hazard risk and vulnerabilities unique to that jurisdiction. This helps to differentiate the jurisdiction's risk and vulnerabilities from that of the planning area overall.

B.3.1 Hazard Identification and Ranking

Table B-4 lists the significance of each hazard for the City of Federal Heights based on the risk assessment and planning team input. The highest risk hazards were determined to be flood, public health hazards, and severe cold weather storms.

Table B-4 Hazards Summary – City of Federal Heights

Hazards	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Cyber Attack	Significant	Limited	Likely	**Medium**
Dam Failure	None	Negligible	Unlikely	**Low**
Drought & Excessive Heat	Extensive	Moderate	Likely	**Medium**
Earthquake	Extensive	Critical	Unlikely	**Low**
Expansive Soils	Extensive	Negligible	Occasional	**Low**
Flood	Significant	Moderate	Likely	**High**
Ground & Surface Water Supply Contamination	Extensive	Critical	Occasional	**Medium**
Hazardous Materials	Significant	Moderate	Likely	**Medium**
Mass Transportation Incident	Significant	Moderate	Occasional	**Medium**
Public Health Hazards	Extensive	Critical	Occasional	**High**
Severe Cold Weather Storms	Extensive	Critical	Highly Likely	**High**
Severe Warm Weather Storms	Extensive	Moderate	Highly Likely	**Medium**
Terrorism & Active Shooters	Significant	Critical	Occasional	**Medium**
Tornadoes & Microbursts	Limited	Moderate	Likely	**Medium**
Wildland Fire	Limited	Moderate	Likely	**Low**

Location/Spatial Extent
Extensive: 50-100% of planning area
Significant: 10-50% of planning area
Limited: Less than 10% of planning area

Potential Severity
Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged
Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged
Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.

Potential of Future Occurrence
Highly Likely: Near 100% probability each year.
Likely: Between 10 and 100% probability per year or at least one chance in ten years.
Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Significance
(Based on the preceding three factors)
High: widespread potential impact
Medium: moderate potential impact
Low: minimal potential impact

The following sections detail vulnerability to specific hazards, where quantifiable, and where it differs from that of the other cities. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas. For a discussion of the methodology used to develop the loss estimates refer to Section 4 of the Base Plan.

For the following hazards, the City's risk does not differ significantly from the rest of the planning area, and they are not profiled further:

- Cyber Attack
- Drought & Excessive Heat
- Ground & Surface Water Supply Contamination
- Hazardous Materials
- Public Health Hazards
- Terrorism & Active Shooters
- Tornadoes & Microbursts

See Section 4.2 for a discussion of assets at risk in the City.

B.3.2 Dam Failure

The City of Federal Heights does not have any exposure to mapped inundation areas, and as such is not at risk to flooding from a dam incident or failure.

B.3.3 Earthquake

The following information details the results of the Hazus-MH scenario summary report specific to the City of Federal Heights. Impacts on persons and households in the planning area were estimated for the 2,500-Year Probabilistic Earthquake. Impacts to the population as estimated by Hazus are estimated based on a 2 p.m. time of occurrence scenario, which is likely to be a worst-case scenario, that there would be four injuries across the city, all of which would be minor and not require hospitalization. No fatalities are estimated in Federal Heights.

Table B-5 Estimated Earthquake Impact on Persons and Households in Federal Heights

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter	Number of Casualties
2,500-Year Earthquake	9	7	4

Source: Hazus-MH Global Summary Report, Wood analysis

The Hazus analysis model estimates about 418 buildings in Federal Heights will be at least moderately damaged. This is over 9% of the buildings in the city. Most of the damage will be concentrated in residential structures. Total building related losses were estimated to be $10.9 million. A summary of these damage estimates is included in Table B-6 and Table B-7 below.

Table B-6 Estimate Building Damage by Occupancy in Federal Heights

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2.58	0.07	0.26	0.04	0.13	0.03	0.03	0.08	0.00	0.09
Commercial	129.37	3.74	16.05	2.50	8.76	2.27	1.74	5.43	0.09	7.53
Education	0.86	0.02	0.09	0.01	0.04	0.01	0.01	0.02	0.00	0.03
Government	3.42	0.10	0.37	0.06	0.19	0.05	0.03	0.09	0.00	0.11
Industrial	27.78	0.80	3.67	0.57	2.12	0.55	0.42	1.30	0.02	1.36
Other Residential	2403.91	69.53	544.50	84.92	351.37	91.14	26.33	82.34	0.89	77.64
Religion	6.90	0.20	0.70	0.11	0.34	0.09	0.05	0.17	0.00	0.23
Single Family	882.34	25.52	75.55	11.78	22.58	5.86	3.38	10.57	0.15	13.02
Total	3,457		641		386		32		1	

Source: Hazus-MH Global Summary Report, Wood analysis

Table B-7 Hazus Building Related Economic Loss Estimates for 2,500 Year Scenario

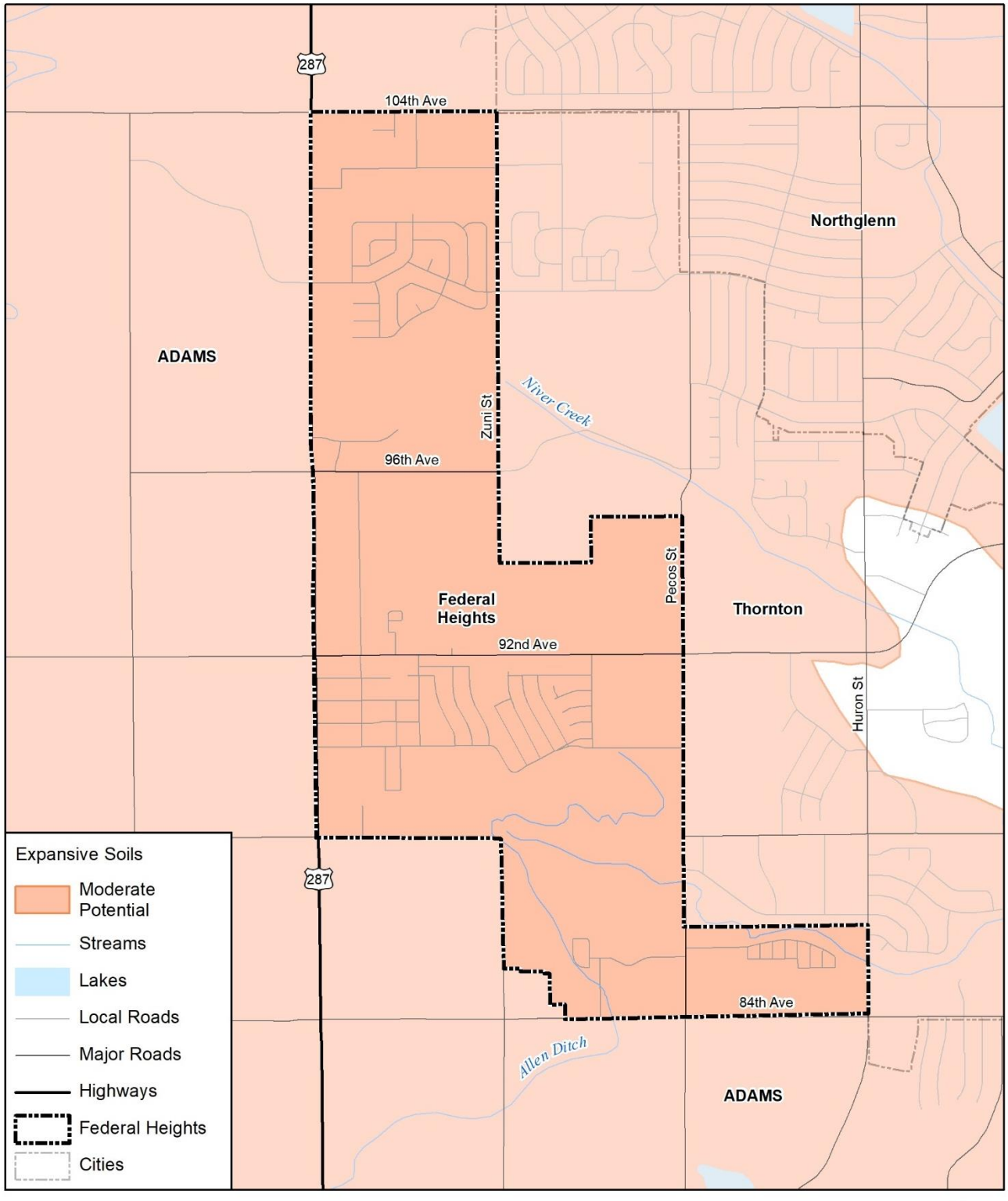
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0000	0.2902	0.0065	0.0106	0.3073
	Capital-Related	0.0000	0.0000	0.2693	0.0037	0.0014	0.2744
	Rental	0.0492	0.1580	0.1517	0.0020	0.0038	0.3647
	Relocation	0.1735	0.6445	0.2105	0.0151	0.0242	1.0678
	Subtotal	**0.2227**	**0.8025**	**0.9217**	**0.0273**	**0.0400**	**2.0142**
Capital Stock Losses							
	Structural	0.2516	1.0259	0.2655	0.0350	0.0268	1.6048
	Non_Structural	1.0059	3.4098	0.7862	0.1388	0.0867	5.4274
	Content	0.4045	0.7874	0.4890	0.0862	0.0575	1.8246
	Inventory	0.0000	0.0000	0.0136	0.0180	0.0007	0.0323
	Subtotal	**1.6620**	**5.2231**	**1.5543**	**0.2780**	**0.1717**	**8.8891**
	Total	**1.88**	**6.03**	**2.48**	**0.31**	**0.21**	**10.90**

Source: Hazus-MH Global Summary Report, Wood analysis

B.3.4 Expansive Soils and Undermined Areas

As shown in Figure B-2, essentially the entire City is at moderate risk of expansive soils.

Figure B-2 Expansive Soils Risk to the City of Federal Heights



B.3.5 Flood

Flood risk in the City of Federal Heights is high. The FEMA 1% annual floodplain in the City contains 173 buildings total, 170 of which are mobile homes. 503 people are at risk, although the low value of the mobile homes means that the estimated property losses are only $4,638,135. There is one critical facility at risk in Federal Heights.

There are no FEMA-mapped 0.2% annual chance flood hazard areas in Federal Heights.

The mapping studies done by the Mile High Flood District (MHFD) show slightly less risk in Federal Heights. The MHFD 1% annual mapped areas in the City contains 465 residents and 158 buildings, 157 of which are mobile homes; estimated flood losses are $4 million.

The MHFD 0.2% annual chance mapped areas contains an additional 71 residents and 24 structures, all of which are mobile homes; total estimated losses are $29 million.

FEMA-mapped flood hazard areas in Federal Heights are shown in Figure B-3. Figure B-4shows the more recent MHFD mapping.

NFIP Participation

Federal Heights joined the National Flood Insurance Program (NFIP) on December 2, 2021. There are currently 8 NFIP-insured properties in the City, with a combined coverage of $903,000. There have been 6 damage claims filed under the NFIP in Federal Heights, and a total of $21,217 has been awarded.

As discussed in Section 4.8.7, there are no Repetitive Loss (RL) or Severe Repetitive Loss (SRL) properties in the City of Federal Heights.

Figure B-3 FEMA Flood Hazard Areas in Federal Heights

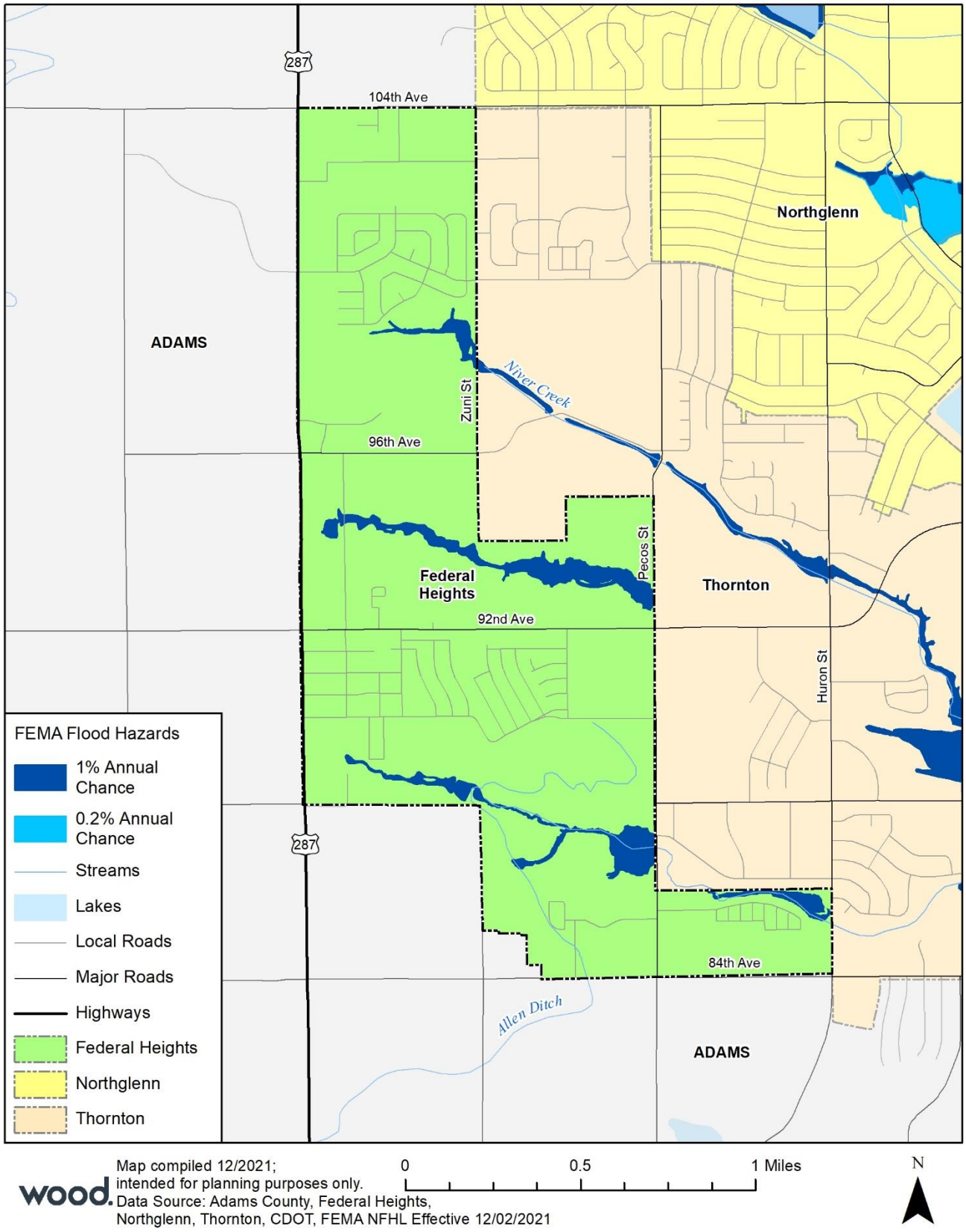
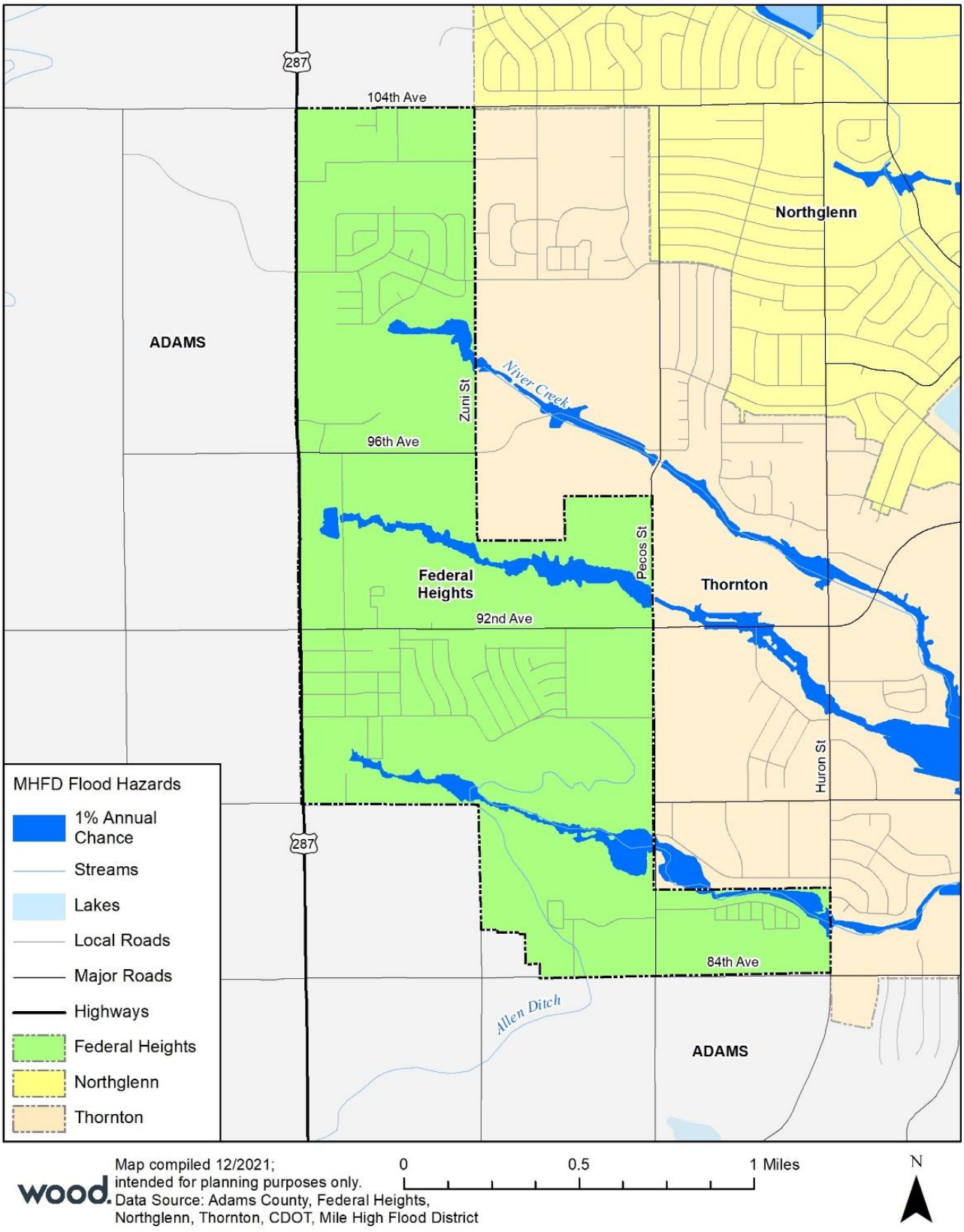


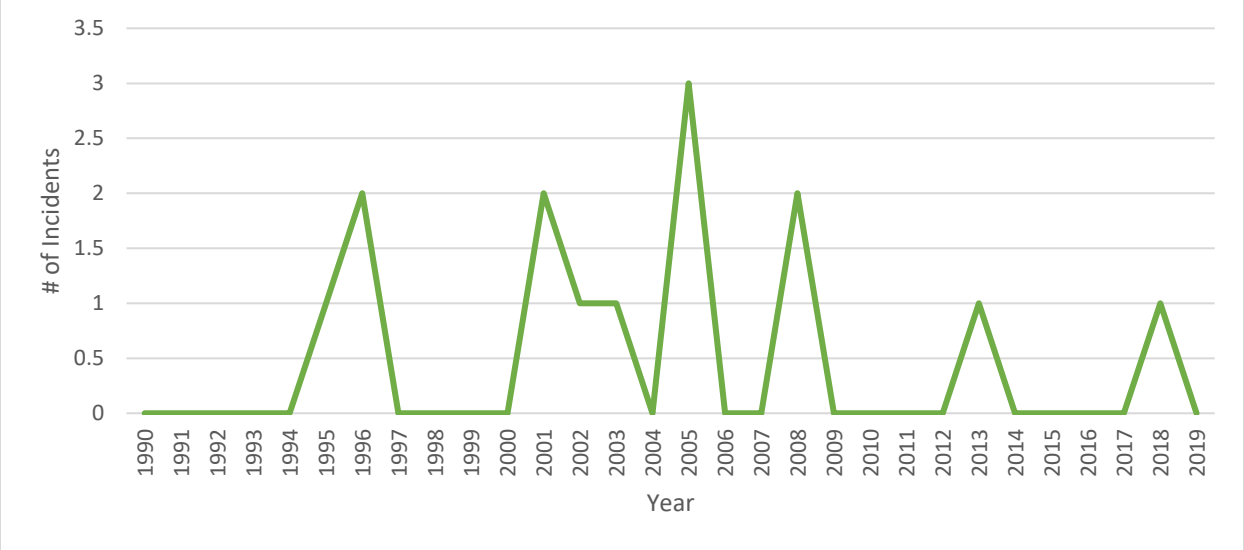
Figure B-4 MHFD Flood Hazard Areas in Federal Heights



B.3.6 Hazardous Materials Incidents

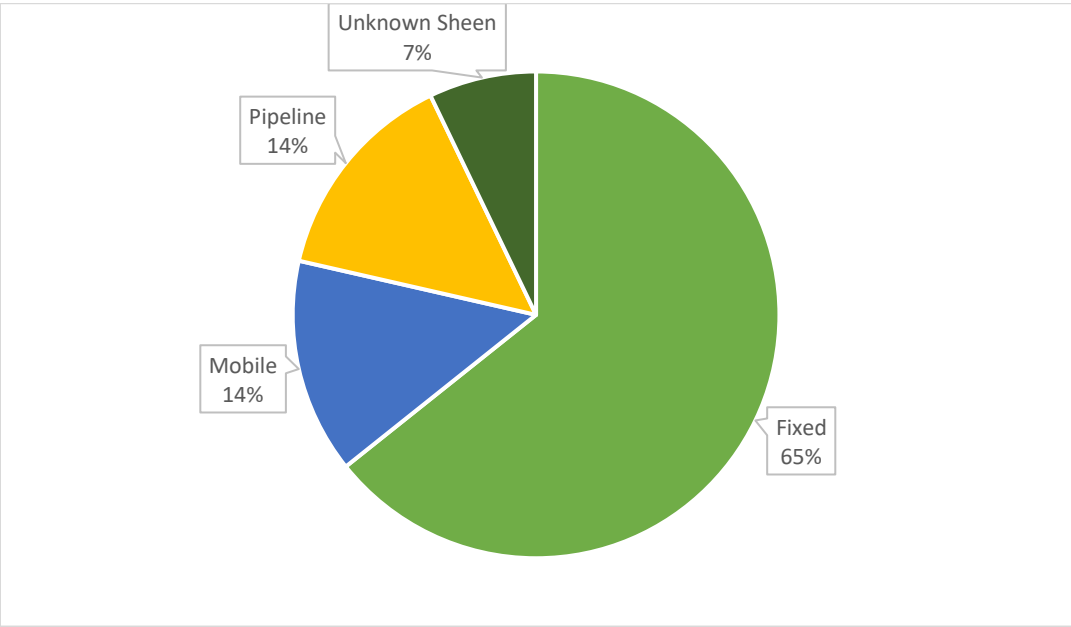
Between 1991 and 2019 there have been 14 hazardous material incidents in Federal Heights. None of these incidents related in casualties or resulted in damages. A majority of past hazardous material incidents in Federal Heights were at fixed sites.

Figure B-5 Number of Hazardous Material Incidents in Federal Heights, 1991-2019



Source: NRC

Figure B-6 Types of Hazardous Material Incidents in Federal Heights, 1991-2019



Source: NRC

B.3.7 Mass Transportation Incident

The City of Federal Heights does not have any rail lines or major highways that cross thorough the city. U.S. Route 287 borders the city to the west. Table B-8 shows there have been 1,701 automotive crashes in Federal Heights between 2010 and March 3, 2022.

Table B-8 Federal Heights Automotive Crashes, 2010-March 3, 2022

Number of Crashes	1,701
Number Of Fatal Crashes	4
Number Of Fatalities	8
Number Of Non-Motorist Fatalities	5
Number Of Serious Injury Crashes	28
Number Of Serious Injuries	162
Number Of Non-Motorist Serious Injuries	46

Source: CDOT Colorado Crash Data Dashboard

B.3.8 Public Health Hazards

Given the fact that cities are ideal breeding grounds for epidemics and virus can grow exponentially in air travel, the impact of public health hazards including pandemic and endemics on Thornton is likely to be very similar to that of the planning area as a whole. Public health responses are typically coordinated at the county level.

As of July 1, 2022, the City of Federal Heights had experienced 4,038 cases of COVID-19, resulting in 227 hospitalizations and 25 deaths.

B.3.9 Severe Cold Weather Storms

Severe cold weather storms typically present similar risks across the planning area; however, jurisdictions with high numbers of elderly residents, a high poverty rate and/or large numbers of rental properties can plan accordingly to provide appropriate services and mitigation assistance during extreme cold weather storm events.

Compared to the State average, the City of Federal Heights has a slightly lower percentage of people over the age of 65, but a much higher proportion of people below the poverty level and a high proportion of renters. Based on these statistics, Federal Heights may have higher social vulnerability to severe cold weather storms.

B.3.10 Wildland Fire

The risk from wildfires is relatively **Low** in Federal Heights. While there are no high or moderate wildfire risk areas in the City, there is an area of lowest wildfire risk where Camenisch Park is located. There are an estimated 429 Federal Heights residents living within that lowest wildfire risk area, along with 151 structures, 142 of which are residences, with a combined value of $213 million. No critical facilities in Federal Heights are located in wildfire risk areas.

However, the December 2021 Marshall Fire in Boulder County showed how deadly wildfires can be if high winds drive them into an urban area, potentially threatening the entire City.

The wildfire risk to the City of Federal Heights is shown in Figure B-7. Figure B-8 shows the Wildland Urban Interface (WUI) areas in and near the City.

Figure B-7 Wildfire Risk in Federal Heights

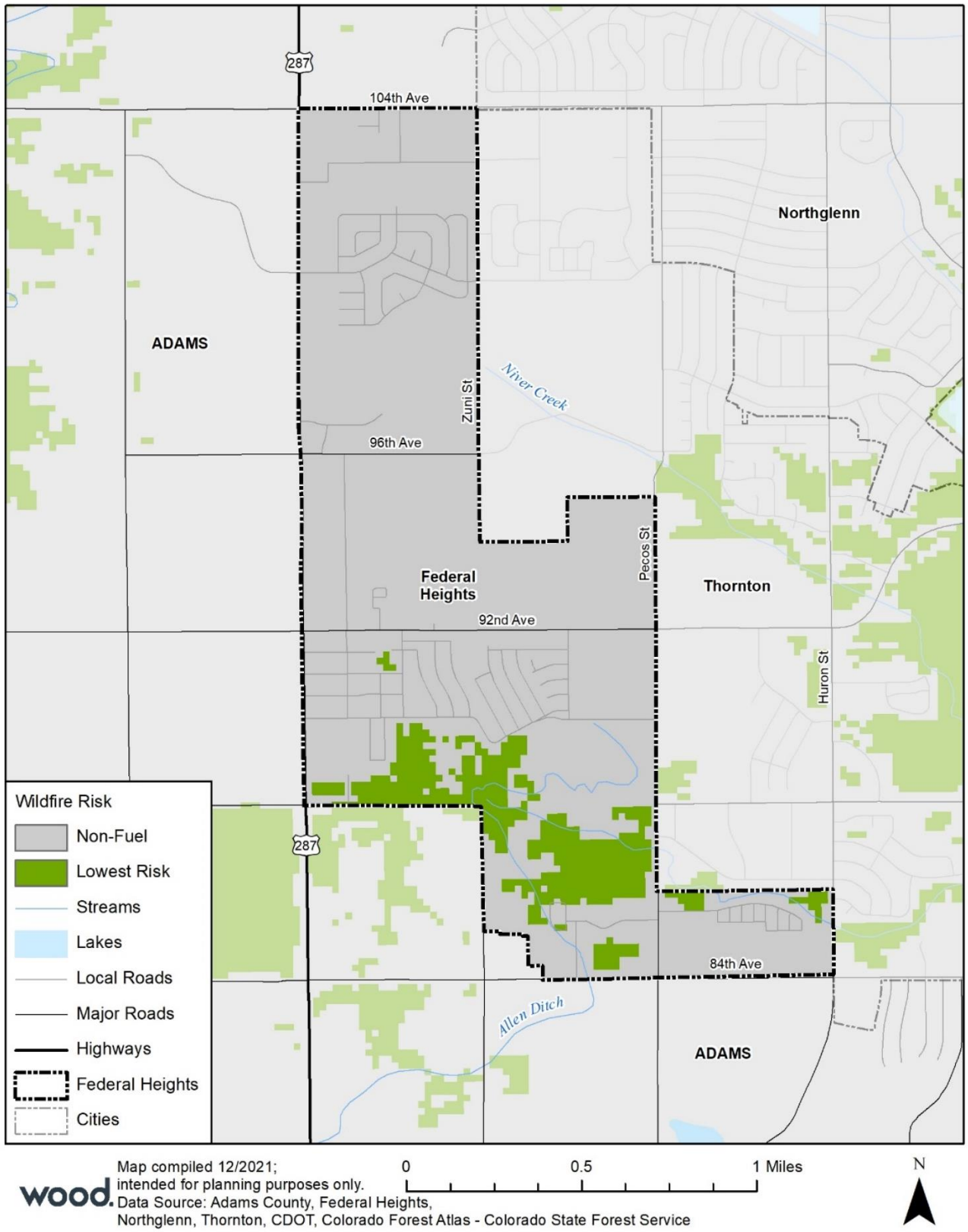
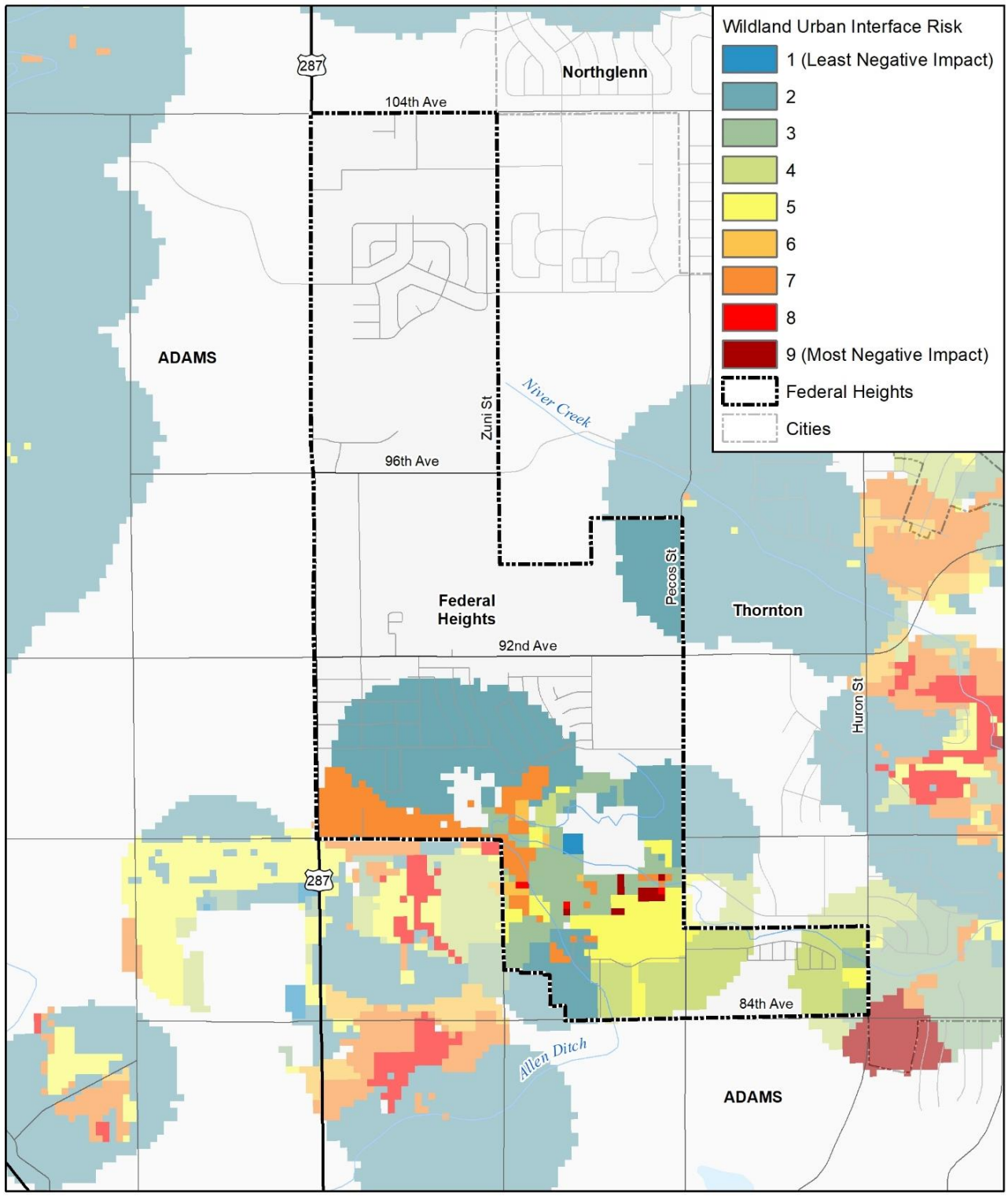


Figure B-8 Wildland Urban Interface (WUI) Risk Areas in Federal Heights



B.4 Mitigation Strategy

The mitigation strategy the goals that guide Federal Heights' mitigation program and the specific activities the City will undertake to reduce losses from the hazards described in the HIRA. The mitigation strategy includes a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. The Federal Heights Planning Team followed the process detailed in Section 5 to update this strategy.

B.4.1 Mitigation Goals

Mitigation Goals are general guidelines that explain what a community wants to achieve with their local hazard mitigation plan. Federal Heights' goals are overarching targets and describe the ideal long-term outcomes envisioned by the community.

- Goal 1: Improve capability to reduce disaster losses
- Goal 2: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 3: Increase public awareness of natural hazards and mitigation options
- Goal 4: Integrate hazard mitigation into other planning mechanisms
- Goal 5: Increase the city's resilience to hazards during all phases of the Emergency Management Cycle
- Goal 6: Increase individual resilience to hazards

B.4.2 2022 Federal Heights Mitigation Action Plan

As discussed in Section 5, the City of Federal Heights had 9 mitigation actions in the 2017 Plan. The City has completed 3 of those. See Table 5-1 in Section 5 for a list of completed actions. The remaining 6 actions have been carried over into 2022. The City also identified 7 new actions, for a total of 13 actions.

Many of these mitigation actions are intended to reduce impacts to existing development. In addition, actions are identified to reduce impacts to future development. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations. Actions that protect critical infrastructure note which lifeline category is protected using the following abbreviations:

- COM: Communications
- ENG: Energy
- FWS: Food, Water, Sheltering
- HAZ: Hazardous Waste
- H&M: Health & Medical
- S&S: Safety & Security
- TRN: Transportation

The City's mitigation actions are listed in Table B-9, which includes information on the mitigation actions, lead and supporting agencies, estimated cost, potential funding sources, and estimated timeline.

Table B-9 City of Federal Heights Mitigation Action Plan

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
FH 1	**Public Health Incident Response.** The plan designates roles and responsibilities to Tri-County Health Department and its divisions. To be efficient in executing the plan, there has to be coordinated planning and training prior to an event.	Public Health	F1, F2, F4, F5, F6; H&M	Tri County Health; All agencies in the three-county plan.	Minimal; Staff time	Ongoing	High	**In Progress.** As counties in the area have been impacted by the worldwide pandemic this particular plan has experienced delays, but will continue to be an important goal going forward.
FH 2	**Maintaining Current Building Codes.** Adopt the most recent edition of the International Building Code and related documents and make appropriate local amendments.	Flood, Severe Storms, Tornado/Severe Wind, Earthquake, Extreme Temperatures, Expansive Soils, Winter Storms.	F1, F6; FWS, ENG, S&S	City of Federal Heights;	$2,600 Every three years; City of Federal Heights annual budget	Updated every 3 years	High	**Annual Implementation.** Updated to the 2018 code. Will be updated again within the next three years.
FH 3	**Maintaining Current Uniform Fire Code.** Adopt the most recent edition of the International Fire Code and make appropriate local amendments.	Wildland Fire	F1, F7; FWS, S&S	City of Federal Heights;	$2,000 Every three years; City of Federal Heights annual budget	Updated every 3 years	High	**Annual Implementation.** Updated to the 2018 code. Will be updated again within the next three years.

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
FH 4	**Improve Upon Hazard Mitigation Efforts Relating to Winter Storms - Large Snow/Ice Accumulation Events Throughout Federal Heights.** Structures in winter storm hazard areas should be designed and built to withstand the projected snow (and ice) loads. Non-occupancy buildings, such as greenhouses and storage sheds, which are not subject to building codes, should be given special attention. High-cost or difficult-to-replace property should not be stored outside in high-risk areas. Critical facilities in areas of high storm hazard should be designed and managed to withstand likely storm impacts such as power outages, personnel shortages, and property damage. Residents and property owners should be informed of storm hazards and educated in safety and mitigation techniques. Snow fencing and related technologies should be constructed in areas where important highways are at risk of blockage during storm events. Utility lines should be placed underground where feasible. Aboveground utility lines should be kept free of potentially damaging vegetation. Adoption and enforcement of appropriate building codes and construction standards can significantly reduce damages caused by severe storms.	Winter Storms	F1, F2, F6; FWS, S&S	City of Federal Heights;	Approximately $6,000,000; City of Federal Heights Urban Renewal District	2017-2023	High	**In Progress.** All new projects and building applications are reviewed and evaluated to ensure compliance with the 2018 building codes.
FH 5	**Address Risks Associated with Climate Change.** The Colorado Climate Change Vulnerability Study produced by the University of Colorado and Colorado State University provides 35 recommendations divided into four categories: assessing, planning and managing for resilience; developing and	Drought, Extreme Temperatures, Flood, Severe Storms, Public Health Hazards, Winter Storm, Wildland Fire	F1, F5, F6; FWS, H&M, S&S	Cities of Thornton, Northglenn, and Federal Heights; Tri-County	Not determined at this time; Undetermined	2023-2028	High	**In Progress.** Assigned to all 3 cities in 2017 Plan. The City has not yet evaluated which recommendations will be implemented and in what priority. This needs to be completed before costs can

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
	sharing information; public engagement; and building capacity.			Health Department				be estimated and funding sources identified.
FH 6	**Flood Threat Assessment & Flood Risk Communication (Website development).** Inventory public assets at risk from flooding and categorize the corresponding risk. Develop an interactive public website tailored to the jurisdiction to educate people about flood risks and specific actions they can take to keep safe during dangerous conditions and minimize flood-related losses.	Flooding	F1, F3, F4, F6; ENG, FWS, H&M	City of Thornton; MHFD	$50,000; City of Thornton, City of Northglenn, City of Federal Heights, MHFD, CWCB, FEMA	2017-2023	High	**In Progress.** Assigned to all 3 cities in 2017 Plan
FH 7	**Firewall Upgrade.** Upgrade firewall to mitigate cyber attacks	Cyber Security Attack;	F3; S&S, COM	Federal Heights;	$10,000 - $100,000; City Budget	2023	Medium	**New in 2022**
FH 8	**Tree Replacements, 90th Ave.** Tree replacement to remove old and diseased trees with new healthy drought resistant trees. Helps mitigate the harmful effects of drought, wind, and water erosion.	Drought/Excessive Heat; Expansive Soils/ Undermined Areas; Flooding; Water Supply Contamination; Wildland fire	F1, F4, F5; FWS, ENG	Building Department; Public Works Department	$100,000 - $1,000,000; State Grants	2022-2023	Medium	**New in 2022**
FH 9	**Old Town Water Main Replacements: Phase 1 of 3.** Replacement of old outdated water mains. Reduces water leaks and waste of water as well as ensures water deliver during adverse weather events such as severe drought and or high-water demands. Additionally ensures the safe and healthy delivery of water mitigating health related hazards associated with contaminated water.	Drought/Excessive Heat; Earthquakes; Expansive Soils/Undermined Areas; Water Supply Contamination; Public Health Hazards	F1, F3, F5, F6; S&S, FWS, H&M, ENG	Public Works; Building Department	$100,000 - $1,000,000; Capital Improvement Plan	2022-2025	High	**New in 2022**
FH 10	**Annual Rotational Cleaning of Outfalls 24" & Larger.** Cleaning of outfalls ensures proper drainage during rain and flood events as well as reduces pooling of water and creating areas for stagnation and insect growth.	Expansive Soils/Undermined Areas; Flooding; Water Supply Contamination;	F1, F4, F5; FWS, H&M	Public Works;	$10,000 - $100,000; City Budget	2022-2026	Medium	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals & Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
FH 11	**Cad to Cad Integration.** Merging of Computer added dispatch systems between North Area Fire agencies.	Cyber Security Attack; Hazardous Materials; Mass Transportation Incident; Public Health Hazards; Severe Cold-Weather Storms; Severe Warm-Weather Storms; Terrorism/ Active Shooter; Tornado/ Microbursts; Wildland Fire; Earthquakes; Flooding; Water Supply Contamination	F1, F2, F3, F4, F5, F6; S&S, H&M, COM, TRN, HAZ	Federal Heights Dispatch/ Police division; Fire Department	$100,000 - $1,000,000; Capital Improvement Plan	2022-2023	High	**New in 2022**
FH 12	**Assess Critical Facilities for Snow Load Capacity.** Assess older critical facilities that may not be up to modern code requirements for snow load. Make improvements or retrofits as needed to increase capacity.	Winter Storm	N1, N2; FWS, H&M, S&S, TRN	Public Works; facility owners	Minimal staff time to conduct assessments; cost for retrofits may vary widely; CIP funds, HMA grants	2023-2025	Medium	**New in 2022**
FH 13	**Fayette Street Pond Outfall Improvements.** The Existing storm water detention pond located at W 91st Dr and Fayette St was constructed without an emergency overflow structure. Additionally, the ponds concrete trickle channel is showing signed of degradation. This project will construct a new overflow structure as well as replace the failing concrete trickle channel.	Flooding	N1, N2; TRN	Public Works	$100,000 - $1,000,000; CIP funds, HMA grants	2022-2024	Medium	**New in 2022**

B.5 Implementation and Plan Maintenance

The City of Federal Heights will follow the Implementation and Maintenance procedures spelled out in Section 6. The City Emergency Manager will be responsible for the monitoring, evaluating, and monitoring the Plan as detailed in Section 6.2.

B.5.1 Implementation and Maintenance of the 2017 Plan

Since the approval of the 2017 Plan, the Federal Heights Planning Team met ___ times. Status of mitigation projects were generally tracked by their lead agencies and status updates were communicated to the HMPC as needed.

B.5.2 Incorporation Into Existing Planning Mechanisms

The City of Federal Heights will seek to incorporate the information in this Plan into other city plans and processes wherever possible, as described in Section 6.3. Specific actions the city will take include:

- The city will attempt to incorporate elements of this plan through the budgeting process on an annual basis with priority given to projects that address the identified hazards within the plan.
- The city will also attempt to incorporate objectives listed within this plan into other plans that the city produces such as emergency response plans and annual assessments, as well as public education events.

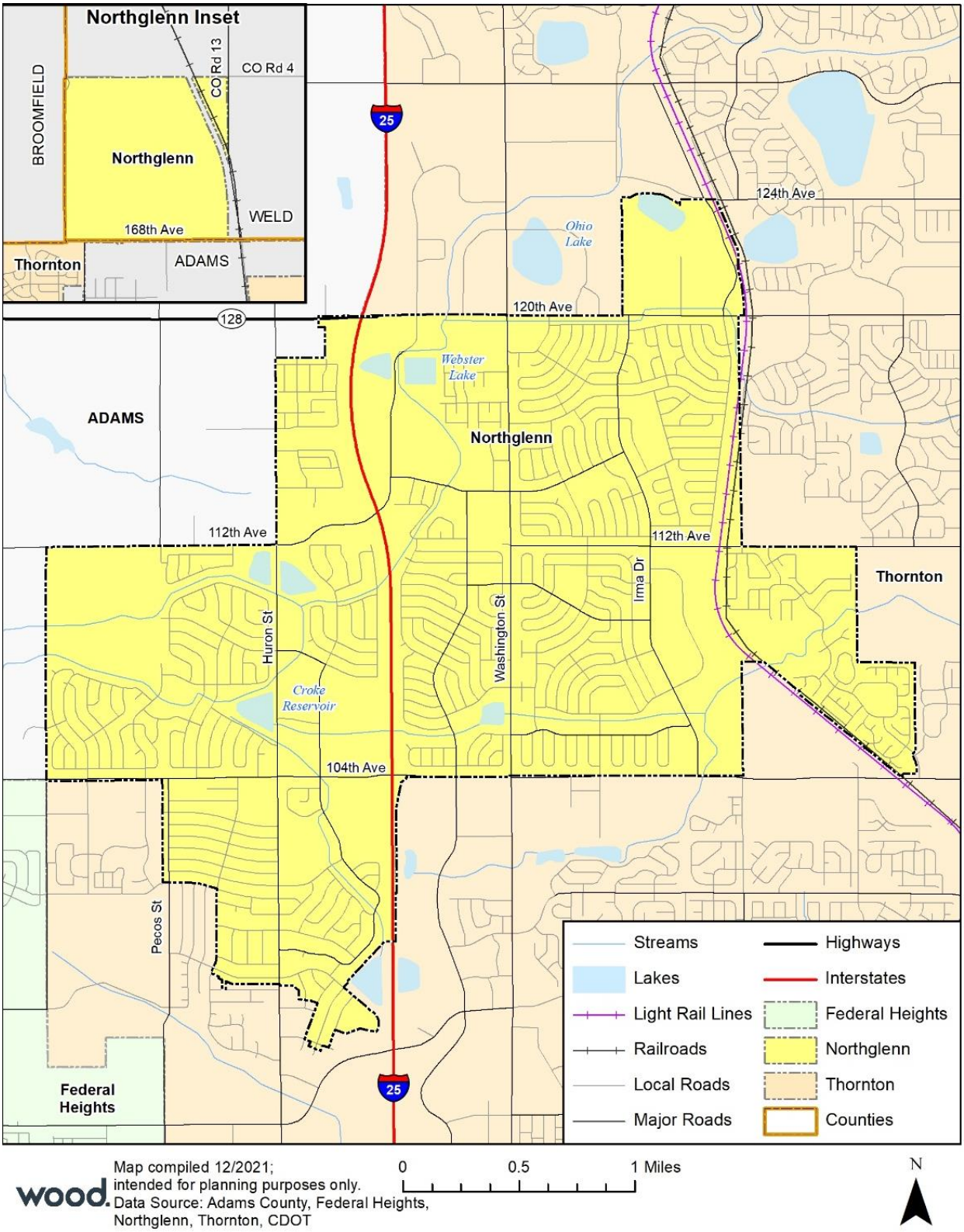
B.5.3 Continued Public Involvement

The City of Federal Heights will make every effort to keep the public informaed and engaged in hazard mitigation, as described in Section 6.4. Specific actions the city will take include:

- Keeping the public informed and updated on relevant hazard mitigation efforts and developments by publishing relevant articles and updates to the cities bi-monthly newsletter.
- The city will also actively particpate in public outreach events to update citizens groups and HOA's on relevant hazards such as floods and fires.
- Finally the city will provide daily and weekly updates to the public on relevant mitigation topics and events through social media sources such facebook, twitter, and the cities website.

C. The City of Northglenn

Figure C-1 The City of Northglenn



C.1 Introduction

This Annex was updated as part of the 2022 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan update process. The City of Northglenn fully participated in the 2022 update process as described in Section 2, to include:

- Participating in the Hazard Mitigation Planning Committee (HMPC)
- Coordinating between different city departments/agencies and stakeholders
- Updating jurisdictional information
- Identifying new mitigation actions
- Coordinating formal adoption

The City had previously participated in the 2017 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan and has been active in implementing that plan as described in Section C.5. A review of jurisdictional priorities found no significant changes in priorities since the last update.

C.2 Community Profile

The City of Northglenn is located northeast of Denver, encompassing land mostly in Adams County but also a small portion in Weld County. It's surrounded by Broomfield and Westminster to the west, Thornton to the North. Northglenn was originally designed to have it's own commercial, recreational, industrial and education areas cascading a shopping complex that was to be located in the area. Also, its central location makes for easy access to Interstate 25, Downtown Denver, Boulder and DIA.

C.2.1 History

In 1959, a land development company called Perl-Mack Co. finished their plans to construct the largest planned community of the time in unincorporated Adams County. The community would include a golf course, six elementary schools, a high school, fire station, churches, parks, shopping center, and other community facilities. By the end of 1962, Perl-Mack constructed 3,000 homes that housed 10,000 residents. The development received recognition from Life magazine as "The most perfectly planned community in America" in 1961.

Residents voted on October 13th of 1964 to incorporate, but they faced opposition from the City of Thornton and the incorporation was postponed. Five years later in 1969, the Colorado Supreme Court ruled in favor of Northglenn that the city could be incorporated. Within the three months after the city's incorporation, elections were held for the first mayor, city council, city clerk, and treasurer. On April 19, 1969, the city was officially incorporated, and the first council meeting was held just two days later, on April 21st.

The 1970's marked an era of growth for the city with the completion of the Community Recreation Center and the High School Park. A post office was built in addition to two shopping centers. In 1976, a three-acre park was dedicated as Centennial Park and included a celebration with the burial of a time capsule, a liberty bell, signing of the city song, and the construction of an American flag in concrete. The city continues to thrive through renovation projects to maintain historic parks and through up-and-coming stores and restaurants in the Webster Lake Promenade.

C.2.2 Demographics

According to the 2020 Census, the population of the City of Northglenn is 39,201. Northglenn has experienced slower growth than the rest of the planning area and the state, but still above the national average. The unemployment rate for the City is above both average compared to the state and nation. 56.1% of the population is White, not Hispanic, followed by Hispanic or Latino at 33.6%. While 90% of the population has at least a high school degree, only 205 individuals have a bachelor's degree or better.

Table C-1 Northglenn Demographic and Social Characteristics

	Northglenn	Colorado	U.S.
Population	39,201	5,773,714	331,449,281
% Growth since 2010	10%	15%	7%
Median Age	32.8	36.7	38.1
Housing Occupancy Rate	95.5%	90.0%	87.9%
% of Housing Units with no Vehicles Available	5.0%	5.1%	8.6%
Median Home Value	$331,200	$343,300	$217,500
Unemployment	4.9%	3.9 %	4.0%
Mean Travel Time to Work (minutes)	28.2	25.8	26.9
Median Household Income	$71,104	$72,331	$62,843
Per Capita Income	$31,072	$38,226	$34,103
% of Individuals Below Poverty Level	7.8%	10.3%	13.4%
% Without Health Insurance	8.8%	7.6%	5.1%
Average Household Size	2.89	2.56	2.62
Households with a broadband internet subscription	86.6%	89.6%	85.2%
% of Population Over 25 with High School Diploma or Higher	90.1%	91.7%	88.0%
% of Population Over 25 with bachelor's degree or Higher	20.0%	40.9%	32.1%
% with Disability	10.1%	10.6%	12.6%
Language other than English spoken at home	18.3%	16.4%	21.5 %
% Foreign born persons	10.9%	9.5%	13.5%

Source: U.S. Census Bureau, American Community Survey

Table C-2 Northglenn Demographics by Race and Sex

	Northglenn	%
Total Population	39,201	-
Male	19,869	50.7%
Female	19,332	49.3%
White, not Hispanic	21,978	56.1%
Hispanic or Latino	13,170	33.6%
Asian	1,235	3.2%
Black	1,030	2.6%
American Indian and Alaska Native	231	0.6%
Native Hawaiian/Pacific Islander	99	0.3%
Some other race	21	0.1%
Two or more races	1,437	3.7%

Source: U.S. Census Bureau, American Community Survey

C.2.3 Housing

As shown in Section 3.4 of the base plan, the City of Northglenn has 13,496 housing units as of the 2020 Census. 67.9% of those are single-unit structures, 22.4% are apartment buildings with 10 or more units, and only 0.1% are mobile homes.

C.2.4 Economy

The largest industries in Northglenn are educational services (16.3%), retail trade (13.5%), construction (10.9%), and manufacturing (9.4%).

Table C-3 Distribution of Industry Type in Northglenn

	Northglenn
Full-time, year-round civilian employed population 16 years and over	16,100
Educational services, and health care and social assistance	2,409
Construction	1,972
Manufacturing	1,863
Retail trade	1,971
Professional, scientific, and management, and administrative and waste management services	1,697
Transportation and warehousing, and utilities:	1,177
Arts, entertainment, and recreation, and accommodation and food services	1,165
Finance and insurance, and real estate and rental and leasing	1,152
Public administration	802
Wholesale trade	737
Other services, except public administration	594
Information	318
Agriculture, forestry, fishing and hunting, and mining:	243

Source: United States Census Bureau

C.2.5 Social Vulnerability

As discussed in Section 3.6 of the base plan, overall social vulnerability in the City of Northglenn is above average or high compared to the rest of the planning area and the state, ranking above average or high in all categories except Housing and Transportation vulnerability.

A closer look at the individual social vulnerability indicators within Northglenn will give local emergency managers, planners, and stakeholders an even clearer picture of where resources should be prioritized in order to reduce vulnerability in the community. It should be noted that even though the city may have relatively fewer people in a SVI category compared to the rest of the state, there are still people in that category who may be disproportionately impacted by disasters. Over time, Northglenn should continue to monitor their social vulnerability as demographic, economic, and housing related conditions change.

C.2.6 Future Development

Adams County as a whole is expected to continue growing, reaching an estimated 800,000 residents by 2050 according to the Colorado State Demography Office. If growth in the City of Northglenn matches this prediction, the City could expect a population of 49,000 by 2035 and 60,000 by 2050. However, this growth may be limited by the City's limited amount of room to expand or develop new housing.

Northglenn will incorporate information from this HMP update to inform strategic decision making. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan

C.2.7 Capability Assessment

Northglenn has numerous existing regulatory and planning mechanisms in place that support hazard mitigation planning efforts. These tools include city subdivision regulations and road and bridge standards, and local zoning regulations. Northglenn has adopted the 2018 International Building Code.

Northglenn is a participant in the National Flood Insurance Program (NFIP). Since it entered the program, the city has adopted the minimum NFIP requirements into its Charter and City Code and Ordinances. The City's floodplain ordinance prohibits most construction in the 1% floodplain. Given the flood hazard and risk in the City of Northglenn and recognizing the importance of the NFIP in mitigating flood losses, an emphasis is placed on continued compliance with the NFIP. 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 and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance.

City of Northglenn Comprehensive Plan (2010)

The City of Northglenn Comprehensive Plan acts as the blueprint for future growth, land use, and development of Northglenn and is the foundation for local planning. It lays out a community's vision and priorities, and describes where, how, and in some cases, when, development will occur. The plan guides long-range decision making involving physical development and any city action that is expected to influence development. The purpose of the plan is to provide the guidance necessary for city leaders to make informed and rational decisions to balance their development goals with the need to provide a quality living environment for existing and future residents.

The plan aids in policy building to ensure orderly growth and to protect the public's best interest. There are many functions of a Comprehensive Plan, including the creation of a collective vision that reflects the intentions and will of the community to decide its future. In addition, the plan assists the city in proactively preparing for the future by guiding development in a fiscally responsible manner and to coordinate public infrastructure investments to ensure adequate provision of public facilities and services.

City of Northglenn Sustainability Plan (2018)

The Colorado front range is already experiencing heat waves, severe wind, droughts, rainstorms, floods, and wildfires, which are expected to increase in the future. These impacts have a negative impact on our economy, stress our natural resources and worsen inequities facing many individuals in our communities. Action is required at all levels, and local governments have a unique role to play in building sustainable communities. With this Plan, Northglenn joins several surrounding communities—Lakewood, Longmont, Westminster, Denver, Arvada, Thornton, and others – that are taking action to increase sustainability.

ASG's Risk Adaption and Advisory Report (RAAR)

Adaptation Services Group's (ASG) Risk Adaptation and Advisory Report (RAAR) is a unique report that connects the dots between academic research, climate modeling and community engagement. The RAAR is the first step in overall adaptation planning for a community. It provides a high-level view of the climate-related risks and hazards affecting community systems, as well as possible adaptation strategies and recommendations. The RAAR presents an introduction to planning for climate adaptation, which the community can then use as a foundation to build upon.

Northglenn Energy Action Plan

This Energy Action Plan outlines tangible steps for the City of Northglenn to move the community toward its energy efficiency and resiliency goals. Xcel Energy Partners in Energy facilitated a series of workshops with the Energy Action Planning Team (planning team), starting in the spring of 2019, to develop this plan. The planning team included representatives from Northglenn's municipal operations, planning, economic development, and communications departments, as well as the school district, the county health department, United Power, and local community stakeholders.

Office of Emergency Management

The Emergency Program Manager's duties shall include, but not be limited to, directing and managing the day to day operations of the Office of Emergency Management, coordinating all emergency management planning and training, coordination and publication of the Northglenn Emergency Plan to include any annexes and appendices thereto, operating the Emergency Management Information System, coordinating inter-governmental agreements or mutual aid agreements as necessary or directed, and providing advice on emergency management to the Director and City Council as required.

In the event of an unusual occurrence or emergency, the Office of Emergency Management shall advise the Mayor and Council of their authority under this article and the Northglenn Emergency Plan, and the

Office of Emergency Management shall respond to the unusual occurrence or emergency pursuant to this article and the Plan.

Police Department

The Northglenn Police Department commits to providing exceptional police services that promote a safe and peaceful community. The members of the Northglenn Police Department are a dedicated team committed to protect life and property, reduce crime, and promote peaceful neighborhoods. We achieve this through strong community partnerships, collaborative problem-solving and ethical enforcement of the law.

Fire Services - North Metro Fire Rescue District

Fire services in Northglenn are provided by North Metro Fire Rescue District. Since 1946, North Metro Fire Rescue District has served to protect its citizens and their property with a high level of care, compassion, and professionalism. North Metro Fire is equipped and committed to ensuring public safety through fire suppression, emergency medical services and patient transportation, hazardous materials response, technical rescues, and wildland firefighting.

Department of Planning and Development Services

The Northglenn Department of Planning and Development administers the city's land use and development functions. This department includes three division: building, neighborhood services, and planning. The purpose of the department is to coordinate the city's new and redevelopment-related activities, help attract and retain quality businesses, and improve the city's image as a desirable place to live and work.

- Realize the city's vision through plan implementation
- Increase public participation and awareness
- Plan for future development and redevelopment
- Promote public health through design and policy development
- Promote environmental awareness
- Administer licenses for keeping chickens and/or bees
- Manage the city's Healthy Eating, Active Living (HEAL) Committee
- Act as staff liaisons for the city's Planning Commission, Historic Preservation Commission and Board of Adjustment.

Public Safety Communications – ADCOM911

Northglenn participates in the Adams County Communication Center Authority (ADCOM911) to provide dispatching services for police, fire, and EMS response in the City.

City Communications Staff

The City Communications team provides timely, accurate information to the media, community, businesses and other community partners regarding city programs, projects, events, and activities to support transparency in government and to foster an informed community. The City Communications team is responsible for operating Channel 8, City of Northglenn social media channels, city website, monthly print newsletter, monthly e-news and more. Another key communications component is the use of CodeRED, led by the Police Department. CodeRED is used to send information to the public via phone (including mobile numbers). Examples of information sent with Code RED include evacuation notices, bio-terrorism alerts, boil water notices, severe weather, and missing child reports.

Public Works Department

The department is responsible for capital improvements, maintenance of the city's transportation and utility infrastructure, city-owned buildings, city-owned fleet and machinery, and trash and recycling collection for single-family residences. The Department also manages water resources and operates a

water treatment plant and a wastewater treatment plant. The Public Works Department provides municipal services through four divisions:

- Engineering: responsible for most capital improvement programs and special projects, annual contracting and right of way permitting
- Maintenance and Operations: The Maintenance and Operations Division inspects and maintains the city's infrastructure. The city has 106 center lane miles of roadway network, 182 miles of water line, 138 miles of sanitary sewer system, and 25 miles of storm line. This division also manages the fleet of city vehicles and city facilities. They also provide trash and recycling services to all residential customers.
- Utilities: The Utilities Division is responsible for providing a clean, safe and dependable supply of drinking water to the city. In addition, the division oversees the treatment of wastewater, so it meets environmental and regulatory standards. The city owns and manages a water treatment plant and a wastewater treatment plant, four elevated water storage tanks, ten lift stations, and one booster station.
- Environmental: The Environmental Division administers programs related to environmental protection within Northglenn. They support the operations of the City's water resources, water and wastewater operations, and are directly tied to federal and state environmental regulations and statutes.

Opportunities for Improvement

While the City has a number of strong capabilities that can be used to support mitigation, there are several areas where those capabilities could be enhanced or improved. Additional training on mitigation for key city staff would help strengthen existing mitigation capabilities and programs. The City could develop Continuity of Operations (COOP) and Continuity of Government (COG) Plans to ensure city government is able to continue to deliver critical services during a disaster or other interruption. The City could also look at building its capability to plan for hazard reduction, resiliency, and transportation, possibly in coordination with the other cities or Adams County. The City could also consider joining the Community Rating System (CRS), although the City's limited number of flood insurance policies may make that cost prohibitive.

C.3 Hazard Identification and Risk Assessment

This section supplements Section 4 of the Base Plan by providing a refined vulnerability assessment specific to the City of Northglenn for those hazards where the risk is significantly different from that of the planning area overall, or where sufficient data exists to conduct mapping and analysis at the municipal level. The risk for each hazard may vary slightly between the three cities due to specific hazard risk and vulnerabilities unique to that jurisdiction. This helps to differentiate the jurisdiction's risk and vulnerabilities from that of the planning area overall.

C.3.1 Hazard Identification and Ranking

Table C-4 lists the significance of each hazard for the City of Northglenn based on the risk assessment and planning team input. The highest risk hazards were determined to be flood, public health hazards, and severe cold weather storms.

Table C-4 Hazards Summary – City of Northglenn

Hazards	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Cyber Attack	Significant	Limited	Likely	**Medium**
Dam Failure	Limited	Moderate	Unlikely	**Low**
Drought & Excessive Heat	Extensive	Moderate	Likely	**Medium**
Earthquake	Extensive	Critical	Unlikely	**Low**
Expansive Soils	Extensive	Negligible	Occasional	**Low**

Hazards	Geographic Extent	Magnitude/ Severity	Probability of Future Occurrence	Overall Significance
Flood	Significant	Moderate	Likely	**High**
Ground & Surface Water Supply Contamination	Extensive	Critical	Occasional	**Medium**
Hazardous Materials	Significant	Moderate	Likely	**Medium**
Mass Transportation Incident	Significant	Moderate	Occasional	**Medium**
Public Health Hazards	Extensive	Critical	Occasional	**High**
Severe Cold Weather Storms	Extensive	Critical	Highly Likely	**High**
Severe Warm Weather Storms	Extensive	Moderate	Highly Likely	**Medium**
Terrorism & Active Shooters	Significant	Critical	Occasional	**Medium**
Tornadoes & Microbursts	Limited	Moderate	Likely	**Medium**
Wildland Fire	Significant	Moderate	Likely	**Medium**

Location/Spatial Extent
Extensive: 50-100% of planning area
Significant: 10-50% of planning area
Limited: Less than 10% of planning area

Potential Severity
Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged
Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged
Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.

Potential of Future Occurrence
Highly Likely: Near 100% probability each year.
Likely: Between 10 and 100% probability per year or at least one chance in ten years.
Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Significance
(Based on the preceding three factors)
High: widespread potential impact
Medium: moderate potential impact
Low: minimal potential impact

The following sections detail vulnerability to specific hazards, where quantifiable, and where it differs from that of the other cities. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas. For a discussion of the methodology used to develop the loss estimates refer to Section 4 of the Base Plan.

For the following hazards, the City's risk does not differ significantly from the rest of the planning area, and they are not profiled further:

- Cyber Attack
- Drought & Excessive Heat
- Ground & Surface Water Supply Contamination
- Hazardous Materials
- Severe Warm Weather Storms
- Terrorism & Active Shooters
- Tornadoes & Microbursts

See Section 4.2 for a discussion of assets at risk in the City.

C.3.2 Dam Failure

The extent of potential dam inundation in the City of Northglenn is limited to the northern portions of Northglenn in Weld County, north of 168th Avenue. This area is largely rural in nature; however, analysis shows there is an estimated $21 million in total property value potentially exposed to dam inundation in this area. See Section 4.4.7 of the base plan for detailed property exposure and critical facilities at risk.

A city-level dam inundation map is included in Appendix X.

C.3.3 Earthquake

The following information details the results of the Hazus-MH scenario summary report specific to the City of Northglenn. Impacts on persons and households in the planning area were estimated for the 2,500-Year probabilistic earthquake. Impacts to the population as estimated by Hazus are detailed in Table C-5. It is estimated in a 2 p.m. time of occurrence scenario, which is likely to be a worst-case scenario, that there would be 16 injuries across the city, two of which would require hospitalization. No fatalities are estimated in Northglenn.

Table C-5 Estimated Earthquake Impact on Persons and Households in Northglenn

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter	Number of Casualties
2,500-Year Earthquake	34	21	16

Source: Hazus-MH Global Summary Report, Wood analysis

The Hazus analysis model estimates about 390 buildings in Northglenn will be at least moderately damaged. This is over 3% of the buildings in the city. Most of the damage will be concentrated in single-family residential structures. Total building related losses were estimated to be $49.54 million. A summary of these damage estimates is included in Table C-6 and Table C-7 below.

Table C-6 Estimated Building Damage by Occupancy in Northglenn

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	16.52	0.17	2.05	0.21	1.18	0.35	0.24	0.45	0.01	0.45
Commercial	409.55	4.17	61.76	6.27	35.16	10.51	7.14	13.27	0.39	16.23
Education	19.87	0.20	2.48	0.25	1.39	0.41	0.25	0.46	0.01	0.52
Government	16.71	0.17	2.52	0.26	1.50	0.45	0.26	0.48	0.01	0.58
Industrial	119.14	1.21	18.55	1.88	11.68	3.49	2.53	4.71	0.10	4.11
Other Residential	453.59	4.62	57.78	5.87	25.26	7.55	3.24	6.02	0.13	5.57
Religion	41.36	0.42	5.28	0.54	2.86	0.85	0.48	0.89	0.03	1.08
Single Family	8746.53	89.04	834.70	84.73	255.40	76.37	39.65	73.71	1.73	71.46
Total	9,823		985		334		54		2	

Source: Hazus-MH Global Summary Report, Wood analysis

Table C-7 Hazus Building Related Economic Loss Estimates for 2,500 Year Scenario

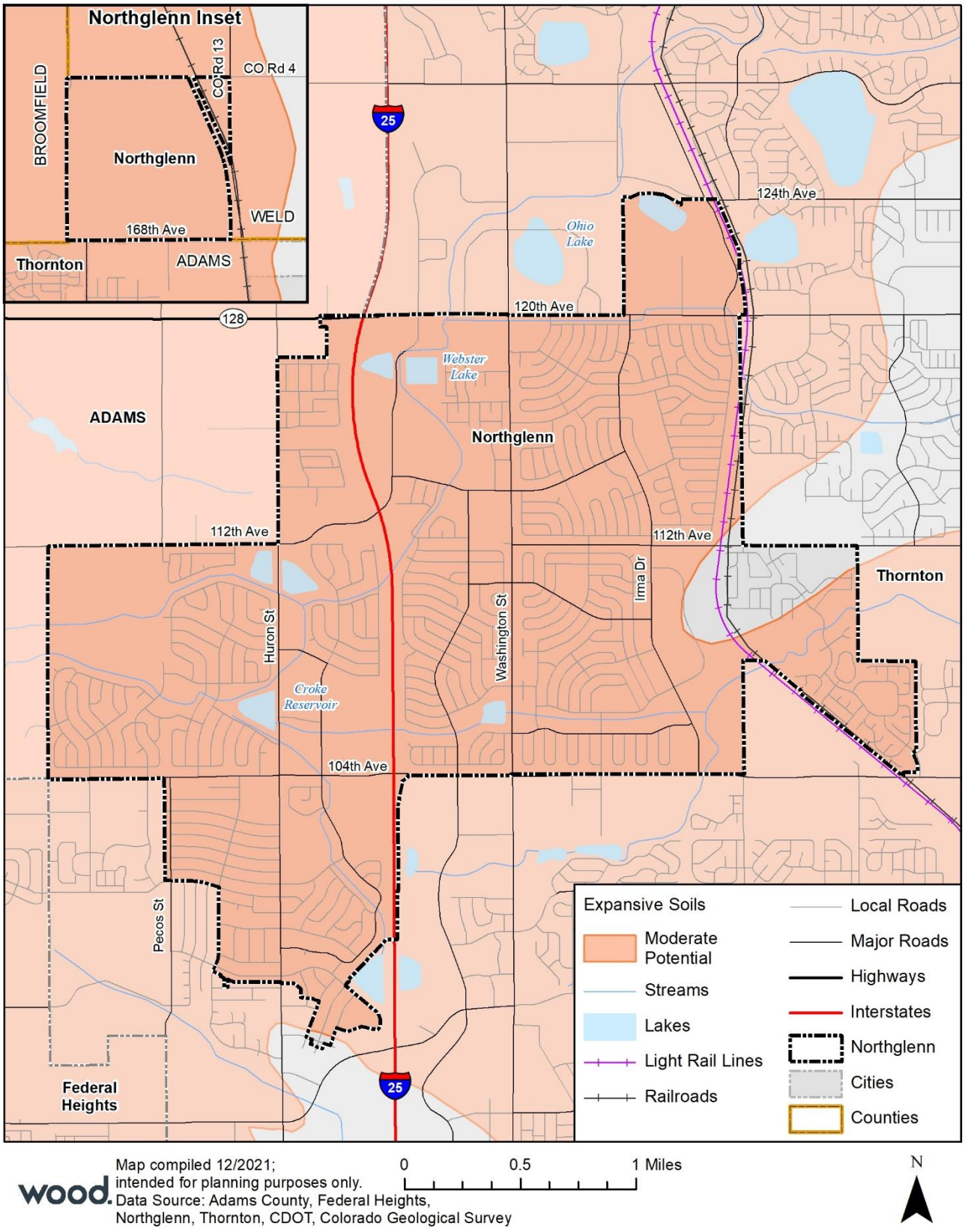
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.1075	1.1250	0.0321	0.1257	1.3903
	Capital-Related	0.0000	0.0456	1.0462	0.0187	0.0240	1.1345
	Rental	0.5779	0.5886	0.6854	0.0120	0.0705	1.9344
	Relocation	2.0400	0.4556	0.9586	0.0864	0.4151	3.9557
	Subtotal	**2.6179**	**1.1973**	**3.8152**	**0.1492**	**0.6353**	**8.4149**
Capital Stock Losses							
	Structural	3.0645	1.0776	1.1146	0.1939	0.3916	5.8422
	Non_Structural	12.2217	7.1813	3.3335	0.7141	1.2866	24.7372
	Content	4.9489	2.1708	2.0304	0.4618	0.7942	10.4061
	Inventory	0.0000	0.0000	0.0494	0.0885	0.0038	0.1417
	Subtotal	**20.2351**	**10.4297**	**6.5279**	**1.4583**	**2.4762**	**41.1272**
	Total	**22.85**	**11.63**	**10.34**	**1.61**	**3.11**	**49.54**

Source: Hazus-MH Global Summary Report, Wood analysis

C.3.4 Expansive Soils and Undermined Areas

As shown in Figure C-2, essentially the entire City is at moderate risk of expansive soils.

Figure C-2 Expansive Soils Risk to the City of Northglenn



C.3.5 Flood

Flood risk in the City of Northglenn is high. The FEMA 1% annual floodplain in the City contains 46 buildings total, 38 of which are residences. 110 people are at risk and estimated property losses are over $22 million. There are 4 critical facilities at 1% risk in Northglenn.

The City's 0.2% annual chance floodplain contains an additional 235 residents and 88 structures, 81 of which are residences (none are mobile homes); total estimated losses are over $23 million. There are 5 critical facilities at 0.2% risk in the City.

The mapping studies done by the Mile High Flood District (MHFD) show significantly less risk in Northglenn. The MHFD 1% annual mapped areas in the City contains 26 residents and 13 buildings, 9 of which are mobile homes; estimated flood losses are $4 million.

The MHFD 0.2% annual chance mapped areas contain an additional 32 residents and 12 structures, 11 of which are residences; total estimated losses are $1 million.

FEMA-mapped flood hazard areas in Northglenn are shown in Figure C-3. Figure C-4 shows the more recent MHFD mapping.

NFIP Participation

Northglenn joined the National Flood Insurance Program (NFIP) on September 15, 1978. There are currently 15 NFIP-insured properties in the City, with a combined coverage of $5,450,000. There have been 15 damage claims filed under the NFIP in Northglenn, and a total of $3,152 has been awarded.

As discussed in Section 4.8.7, there are no Repetitive Loss (RL) or Severe Repetitive Loss (SRL) properties in the City of Northglenn.

Figure C-3 FEMA Special Flood Hazard Areas in Northglenn

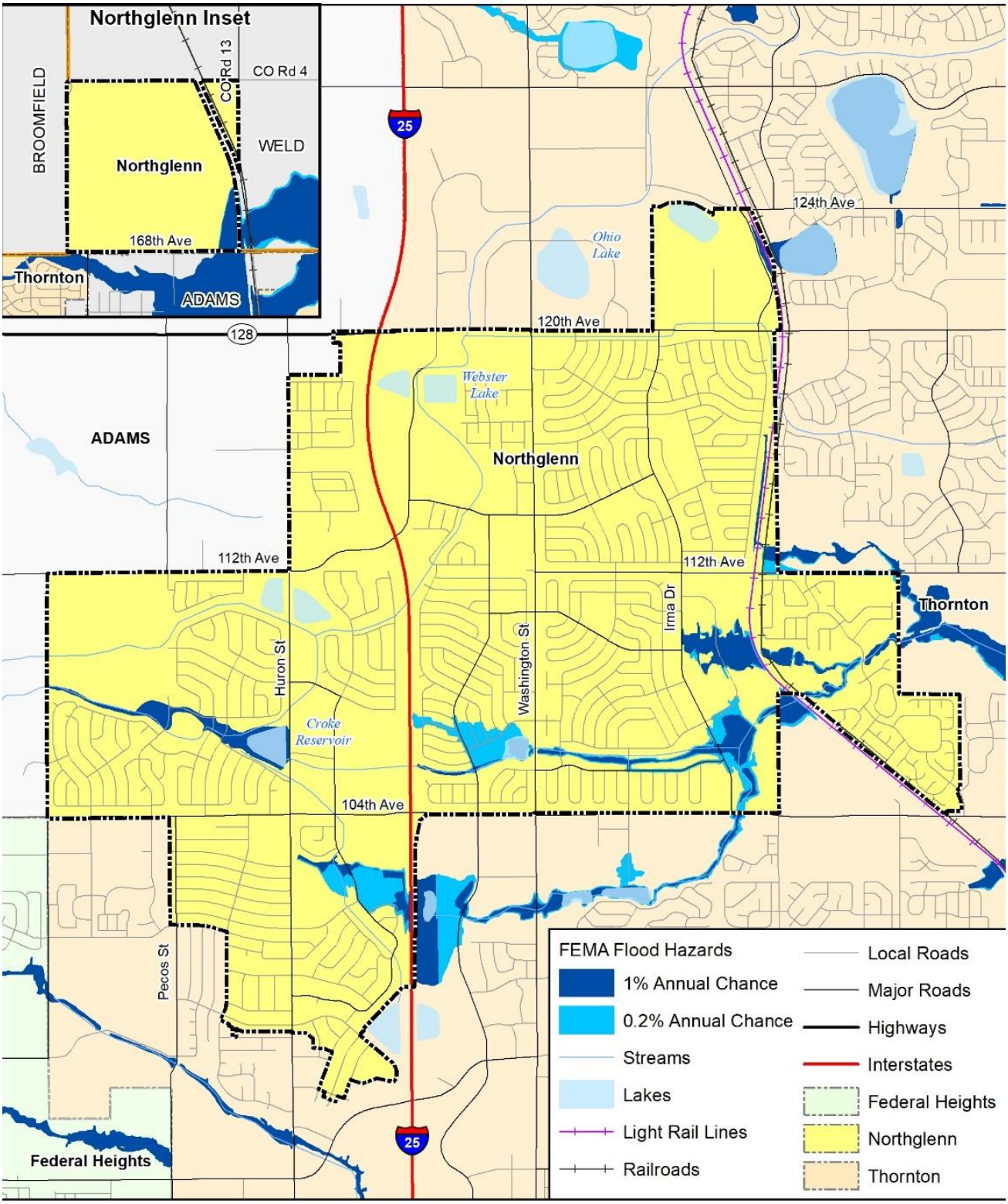
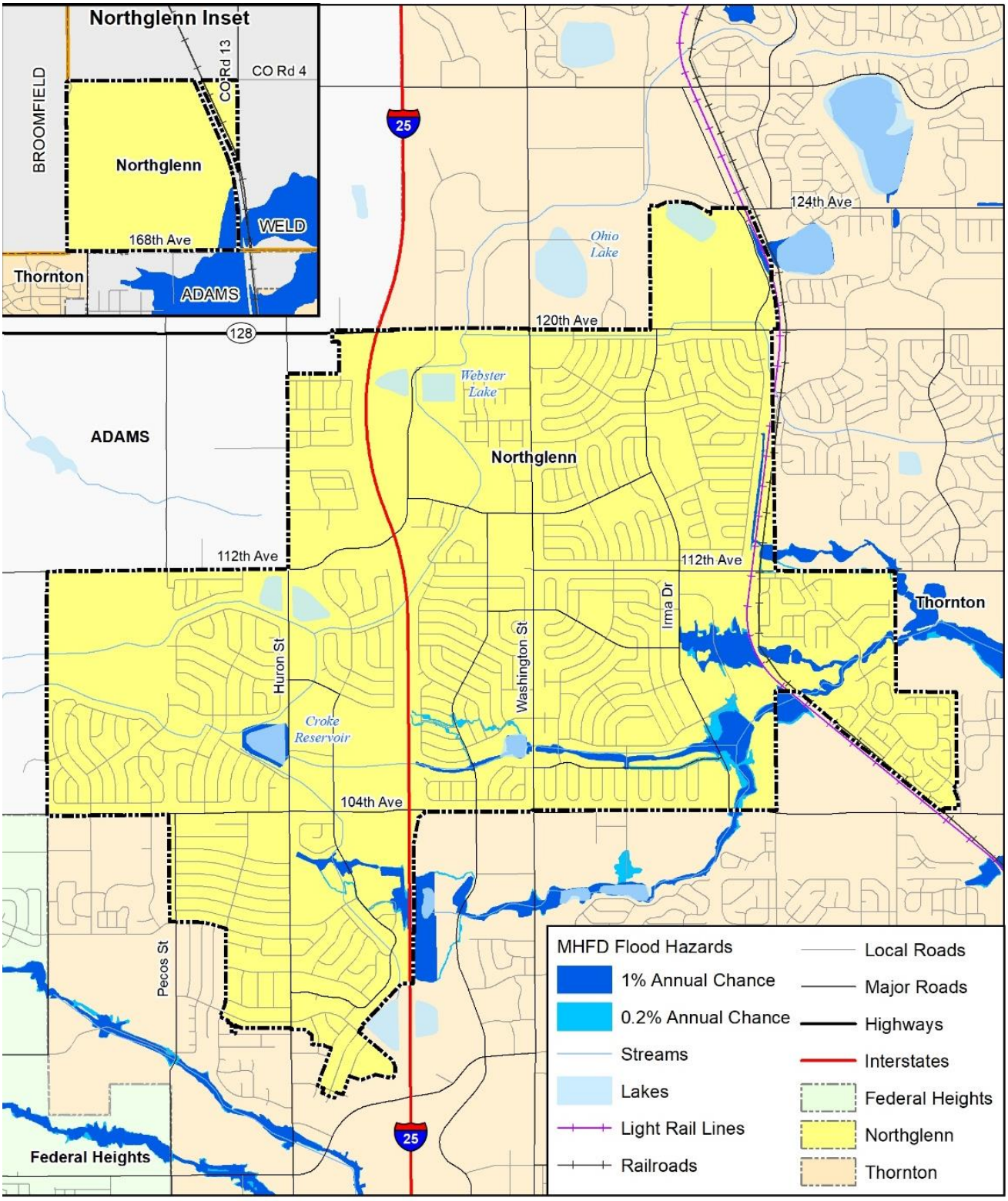


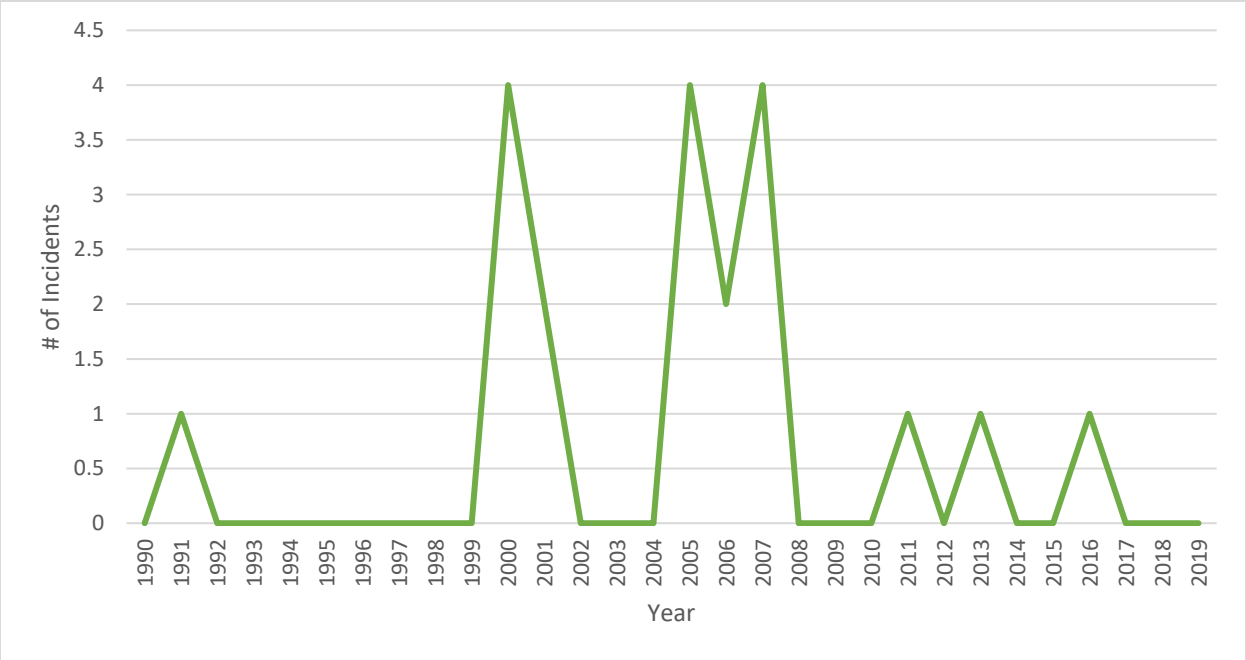
Figure C-4 MHFD Flood Hazard Areas in Northglenn



C.3.6 Hazardous Materials

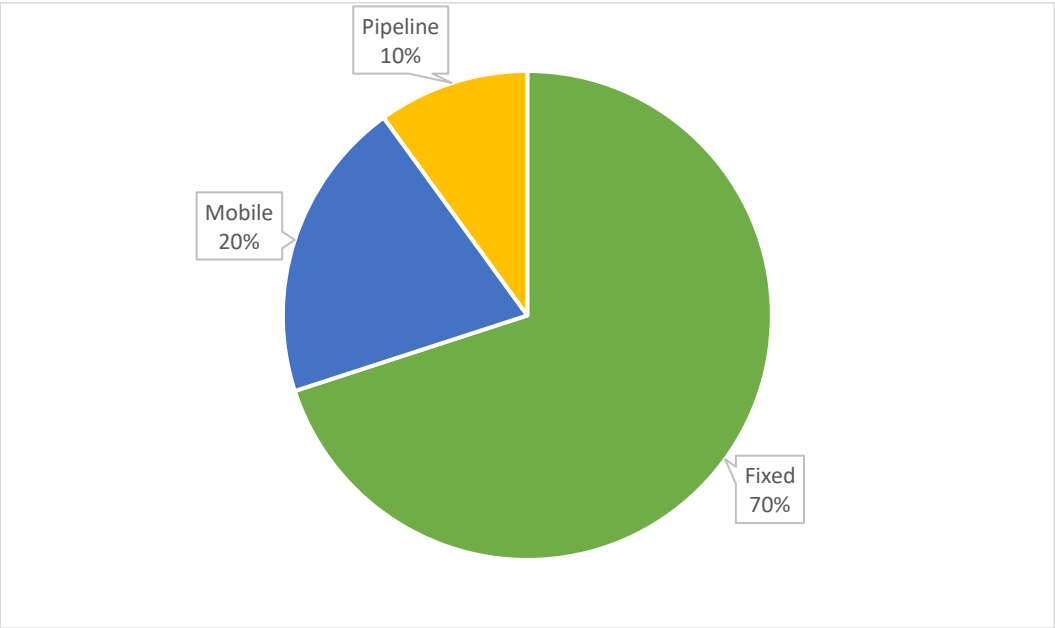
Between 1991 and 2019 there have been 20 hazardous material incidents in Northglenn. None of these incidents related in casualties or resulted in damages. One incident resulted in an evacuation of six people. A majority of past hazardous material incidents in Northglenn were at fixed sites.

Figure C-5 Number of Hazardous Material Incidents in Northglenn, 1991-2019



Source: NRC

Figure C-6 Types of Hazardous Material Incidents in Northglenn, 1991-2019



Source: NRC

C.3.7 Mass Transportation Incident

One major highway, Interstate 25, bisects the City of Northglenn. The N Line, a commuter rail line, and portions of the Union Pacific line also crosses through the city. Table C-8 shows there have been 10,102 automotive crashes in Northglenn between 2010 and March 3, 2022.

Table C-8 Northglenn Automotive Crashes, 2010-March 3, 2022

Number of Crashes	10,012
Number Of Fatal Crashes	22
Number Of Fatalities	44
Number Of Non-Motorist Fatalities	4
Number Of Serious Injury Crashes	111
Number Of Serious Injuries	679
Number Of Non-Motorist Serious Injuries	120

Source: CDOT Colorado Crash Data Dashboard

C.3.8 Public Health Hazards

Given the fact that cities are ideal breeding grounds for epidemics and virus can grow exponentially in air travel, the impact of public health hazards including pandemic and endemics on Thornton is likely to be very similar to that of the planning area as a whole. Public health responses are typically coordinated at the county level.

As of July 1, 2022, the City of Northglenn had experienced 10,749 cases of COVID-19, resulting in 501 hospitalizations and 109 deaths.

C.3.9 Severe Cold Weather Storms

Severe cold weather storms typically present similar risks across the planning area; however, jurisdictions with high numbers of elderly residents, a high poverty rate and/or large numbers of rental properties can plan accordingly to provide appropriate services and mitigation assistance during extreme cold weather storm events.

Compared to the State average, the City of Northglenn has a slightly lower percentage of people over the age of 65, but a higher proportion of people below the poverty level and a much higher proportion of renters. Based on these statistics, Northglenn may have higher social vulnerability to severe cold weather storms.

C.3.10 Wildfire

The risk from wildfires in Northglenn is **Medium**. There are an estimated 844 Northglenn residents living in wildfire risk area, although 744 (92%) of them are at the lowest wildfire risk category. There are a total of 414 buildings in wildfire risk areas, 49 at moderate risk, 43 at low risk, and 322 at the lowest risk; the combined value of properties at risk is $742 million, although $702 million of that are at the lowest risk. There are three critical facilities located within the lowest wildfire risk are in the city.

However, the December 2021 Marshall Fire in Boulder County showed how deadly wildfires can be if high winds drive them into an urban area, potentially threatening the entire City.

The wildfire risk to the City of Northglenn is shown in Figure C-7. Figure C-8 shows the Wildland Urban Interface (WUI) areas in and near the City.

Figure C-7 Wildfire Risk in Northglenn

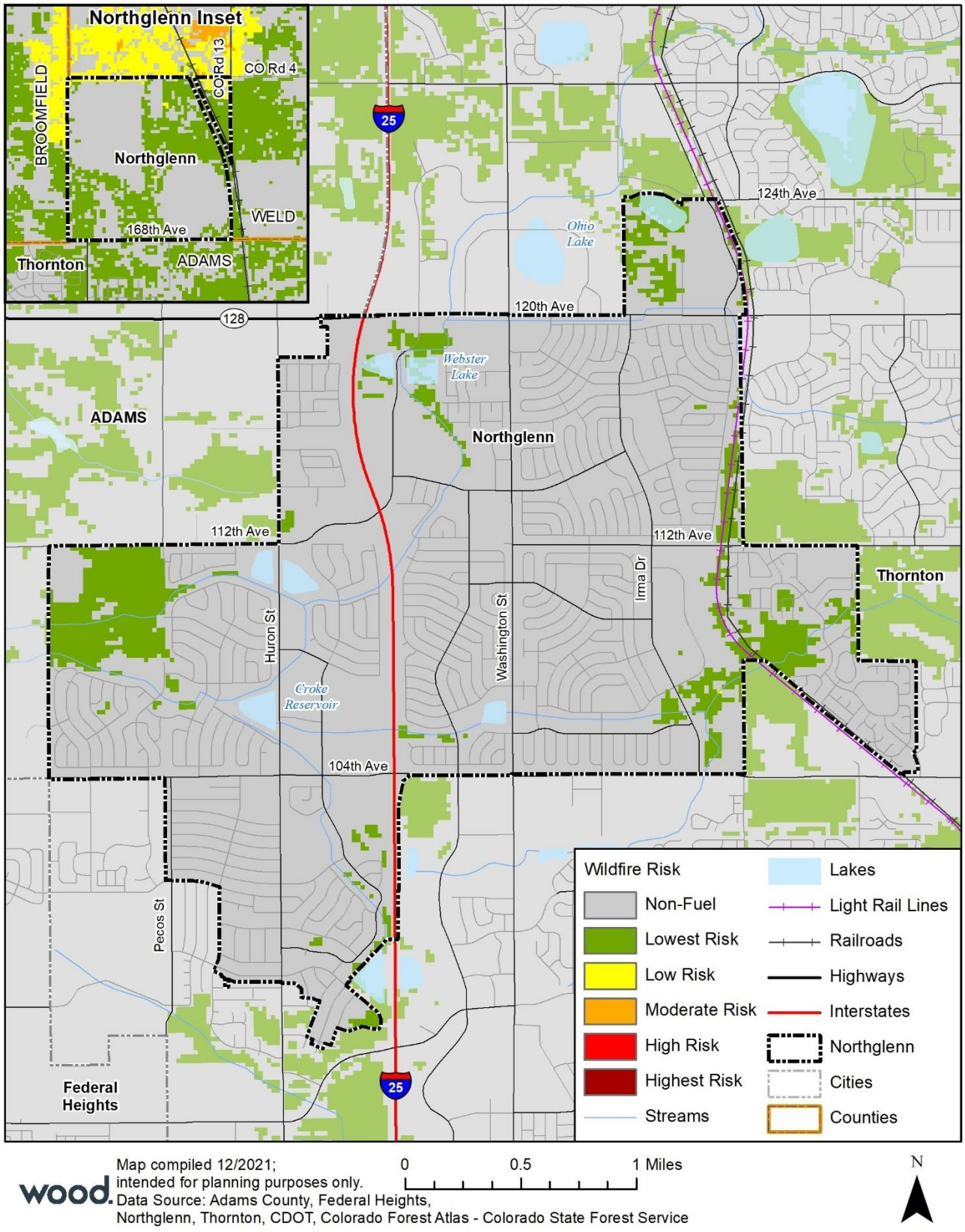
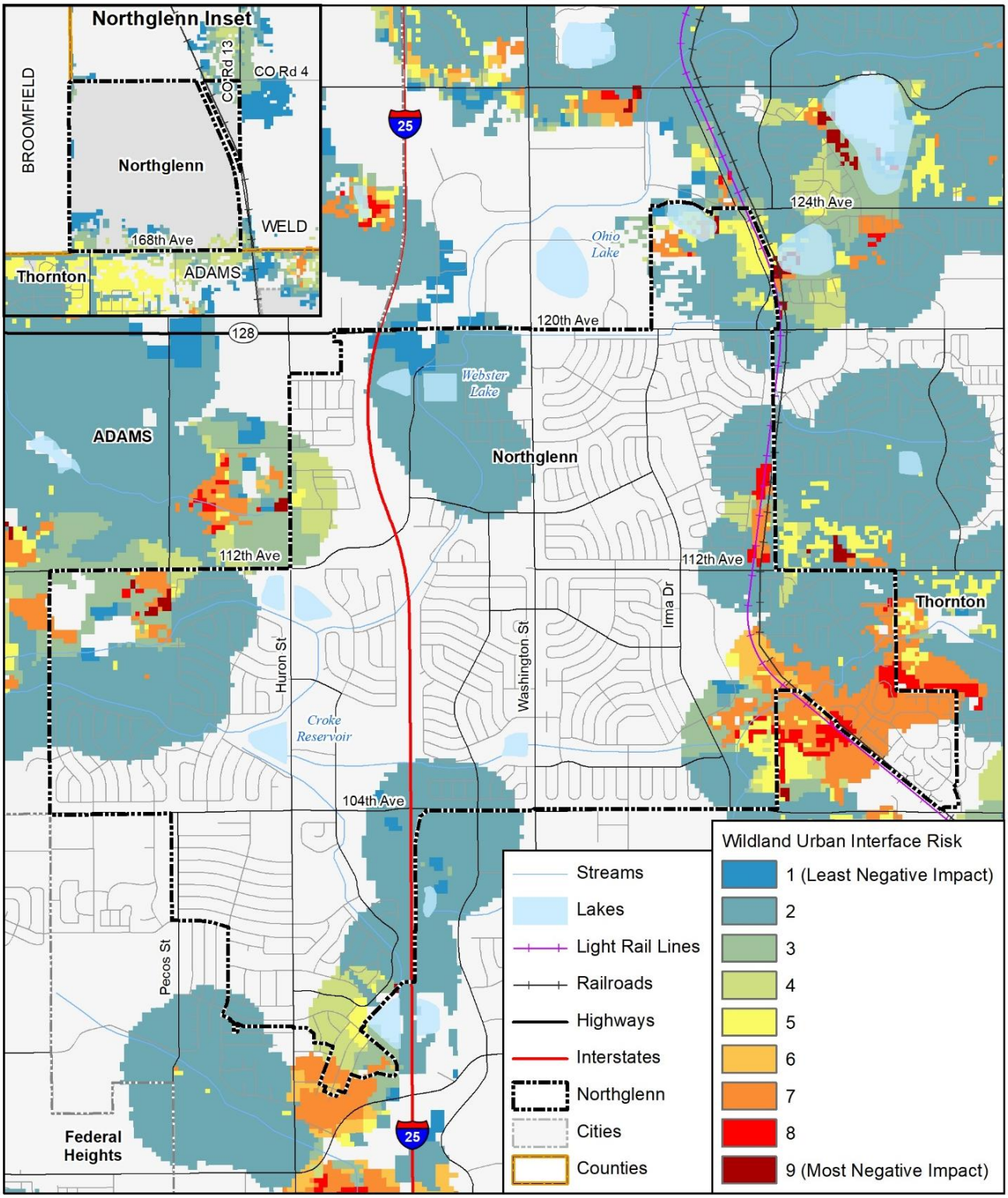


Figure C-8 Wildland Urban Interface (WUI) Areas in Northglenn



C.4 Mitigation Strategy

The mitigation strategy the goals that guide Northglenn's mitigation program and the specific activities the City will undertake to reduce losses from the hazards described in the HIRA. The mitigation strategy includes a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. The Northglenn Planning Team followed the process detailed in Section 5 to update this strategy.

C.4.1 Mitigation Goals

Mitigation Goals are general guidelines that explain what a community wants to achieve with their local hazard mitigation plan. Goals are overarching targets and describe the ideal long-term outcomes envisioned by the community.

- Goal 1: Protect people, property, and natural resources
- Goal 2: Improve capability to reduce disaster losses
- Goal 3: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 4: Increase public awareness of natural hazards and mitigation options

C.4.2 2022 Northglenn Mitigation Action Plan

As discussed in Section 5, the City of Northglenn had 8 mitigation actions in the 2017 Plan. The City has completed 5 of those. See Table 5-1 in Section 5 for a list of completed actions. The remaining 3 actions have been carried over into 2022. The City also identified 7 new actions, for a total of 10 actions.

Many of these mitigation actions are intended to reduce impacts to existing development. In addition, actions are identified to reduce impacts to future development. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations. Actions that protect critical infrastructure note which lifeline category is protected using the following abbreviations:

- COM: Communications
- ENG: Energy
- FWS: Food, Water, Sheltering
- HAZ: Hazardous Waste
- H&M: Health & Medical
- S&S: Safety & Security
- TRN: Transportation

The City's mitigation actions are listed in Table C-9, which includes information on the mitigation actions, lead and supporting agencies, estimated cost, potential funding sources, and estimated timeline.

Table C-9 City of Northglenn Mitigation Action Plan

#	Title and Description	Hazards Mitigated	Goals; Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
NG 1	**Grange Hall Creek.** Improve capacity at both streets to accommodate 100-year event, channel improvements between Washington St and Irma Dr. for increased conveyance.	Flooding & Severe Storm	N1, N2; FWS, S&S	City of Northglenn; MHFD	$ 2.6 million; City of Northglenn & MHFD	2027	Medium	**Not Started.** This project is on our list of to-dos, but the Stormwater Fund doesn't have enough reserves to do the project at this point. So, we will do the project eventually, but it hasn't been completed.
NG 2	**Address Risks Associated with Climate Change.** The Colorado Climate Change Vulnerability Study produced by the University of Colorado and Colorado State University provides 35 recommendations divided into four categories: assessing, planning, and managing for resilience; developing and sharing information; public engagement; and building capacity.	Drought, Extreme Temperatures, Flood, Severe Storms, Public Health Hazards, Winter Storm, Wildland Fire	N1, N2, N6, N7; FWS, S&S	Cities of Thornton, Northglenn, and Federal Heights.; Tri-County Health Department	Not determined at this time; Undetermined	2023-2028	Medium	**In Progress.** Assigned to all 3 cities in 2017 Plan. The City has started this work through the Risk Advisory and Adaptation Report. The City has not yet evaluated which recommendations will be implemented and in what priority. This needs to be completed before costs can be estimated and funding sources identified. Recommendations and Policy decision will be influenced by the identified risks in that report.
NG 3	**Flood Threat Assessment & Flood Risk Communication (Website development).** Inventory public assets at risk from flooding and categorize the corresponding risk. Develop an interactive public website tailored to each jurisdiction to educate people about flood risks and specific actions they can take to keep safe during dangerous conditions and minimize flood-related losses.	Flooding	N1, N2, N4, N5, N7; COM, FWS, S&S	City of Thornton; MHFD	$50,000; City of Thornton, City of Northglenn, City of Federal Heights, MHFD, CWCB, FEMA	2027	Low	**Not Started.** Assigned to all 3 cities in 2017 Plan - Flood risk comms has not been requested since the Communications Director has been here. Has indicated she would be happy to put together a plan if our Environmental Manager and Stormwater Coordinator think is necessary. Our Stormwater Coordinator has indicated that our system is able to handle the 100-year flood, so we hadn't had

#	Title and Description	Hazards Mitigated	Goals; Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
								a need to do this work. I would say that I think that we can work on completing an assessment over the next few years, given some of the changes we're seeing in our climate patterns.
NG 4	**Water Aquifer Storage and Recovery.** Utilizing confined aquifer storage for water supply storage and drought resiliency.	Drought/Excessive Heat;	N1; FWS, H&M	City of Northglenn - Water Resources; NA	More than $1,000,000; City Budget	Ongoing - pilot study this year	High	**New in 2022**
NG 5	**Standley Lake spillway raise project.** Project raises existing spillway level for Standley Lake an additional 3'. Provides additional water supply storage for drought resiliency and provides additional protection for downstream flooding.	Drought/Excessive Heat; Flooding;	N1, N2; FWS	City of Northglenn Water Resources; Thornton and Westminster (stakeholders in Standley Lake)	More than $1,000,000; City Budget	2024 - still in design	Medium	**New in 2022**
NG 6	**Wildfire water treatment response plan.** Plan to address water treatment issues related to wildfire impacts within the watershed as well as plans for sustainable water treatment in the case of urban wildfire.	Wildland Fire;	N1, N2; FWS, H&M	City of Northglenn - Water Treatment;	$100,000 - $1,000,000; City Budget	2023	High	**New in 2022**
NG 7	**Bull Reservoir asphalt liner replacement.** Replace entire asphalt cover on dam crest and upstream dam bank to protect against wave action and erosion. Current liner is 40+ years old and is failing in locations.	Dam/Levee Failure; Flooding;	N1, N2; S&S, H&M	City of Northglenn - Water Resources;	More than $1,000,000; Capital Improvement Plan	2024 or beyond	High	**New in 2022**

#	Title and Description	Hazards Mitigated	Goals; Lifelines	Lead Agency & Partners	Cost Estimate & Funding	Timeline	Priority	Status and Implementation Notes
NG 8	**Fire Mitigation.** Removal of dead trees and other natural fuels along the Niver canal.	Drought/Excessive Heat; Wildland Fire;	N1, N2, N4; S&S	Northglenn; North Metro Fire	$100,000 - $1,000,000; State Grants	2023-2024	Medium	**New in 2022**
NG 9	**Grange Hall Creek at York & 112th drainage way**. Improvements to minimize flooding over York St. including: Box covert, Straightening the channel, Drop structures	Flooding;	N1, N2; TRN	City of Northglenn; City of Thornton, ROW owner)	More than $1,000,000; Other	5-10 years	Low	**New in 2022**
NG 10	**Assess Critical Facilities for Snow Load Capacity.** Assess older critical facilities that may not be up to modern code requirements for snow load. Make improvements or retrofits as needed to increase capacity.	Winter Storm	N1, N2; FWS, H&M, S&S, TRN	City of Northglenn; facility owners	Minimal staff time to conduct assessments; cost for retrofits may vary widely; CIP funds, HMA grants	2-5 years	Medium	**New in 2022**

C.5 Implementation and Maintenance

The City of Northglenn will follow the Implementation and Maintenance procedures spelled out in Section 6. The City Emergency Manager will be responsible for the monitoring, evaluating, and monitoring the Plan as detailed in Section 6.2.

C.5.1 Implementation and Maintenance of the 2017 Plan

The Northglenn Planning Team has not formally met since the approval of the 2017 Plan, but has remained in communication through emails and phone calls. Status of mitigation projects were generally tracked by their lead agencies and status updates were communicated to the HMPC as needed.

C.5.2 Incorporation Into Existing Planning Mechanisms

The City of Northglenn will seek to incorporate the information in this Plan into other city plans and processes wherever possible, as described in Section 6.3. Specific actions the city will take include:

- The City of Northglenn will integrate recommendations into the Comprehensive rewrite currently in process and estimated to be adopted in 2023.

C.5.3 Continued Public Involvement

The City of Northglenn will make every effort to keep the public informaed and engaged in hazard mitigation, as described in Section 6.4. Specific actions the city will take include:

- Once the hazard mitigation plan is finalized, city communications staff will push out the information on all city platforms.
- Communications staff will periodically include emergency preparedness messages in the monthly print newsletter that is mailed to every address in the city and social media. Messaging will target seasonal risks and/or current conditions.
- City and police department communications staff will continuously promote the CodeRED program and encourage residents to register (or update) mobile phone information in the system to tie the number to a geographic area to enhance emergency communications to residents.

Appendix A: Adoption Resolutions

DocuSign Envelope ID: 1065DA21-4F20-49E9-A251-29ACAA0362A2

RESOLUTION

A RESOLUTION ADOPTING THE 2023 THORNTON, FEDERAL HEIGHTS, AND NORTHGLENN HAZARD MITIGATION PLAN.

WHEREAS, Thornton previously adopted the 2017 Thornton, Federal Heights, and Northglenn Natural Hazard Mitigation Plan (2017 Plan), which expired in April 2022; and

WHEREAS, under the Federal Disaster Mitigation Act of 2000, an adopted hazard mitigation plan is required as a condition of future funding for mitigation projects under Federal Emergency Management Agency (FEMA) pre- and post-disaster grant programs; and

WHEREAS, in anticipation of the expiration of the 2017 Plan, Thornton invited the neighboring cities of Federal Heights and Northglenn to participate in the drafting of an updated hazard mitigation plan and entered into an Intergovernmental Agreement on April 13, 2021 to define the cooperative working relationship among the three cities in regard to the updated plan; and

WHEREAS, Thornton, Federal Heights, and Northglenn have drafted the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan (2023 Plan), attached to this resolution as Exhibit A; and

WHEREAS, the 2023 Plan expressly states that it has been prepared in accordance with FEMA requirements, Title 44 of the Federal Code of Regulations, part 201.6; and

WHEREAS, the Colorado Division of Homeland Security and Emergency Management and Federal Emergency Management Agency (FEMA) have reviewed the 2023 Plan and approved it contingent upon adoption by all three cooperating cities.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF THORNTON, COLORADO, AS FOLLOWS:

That City Council hereby adopts the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan, attached as Exhibit A, to include all portions of the 2023 Plan except Annex B, which applies only to the City of Federal Heights, and Annex C, which applies only to the City of Northglenn.

PASSED AND ADOPTED at a regular meeting of the City Council of the City of Thornton, Colorado, on April 11, 2023.

DocuSign Envelope ID: 1065DA21-4F20-49E9-A251-29ACAA0362A2

CITY OF THORNTON, COLORADO

DocuSigned by:
Jan Kulmann
D99FCDF39C4145E...

Jan Kulmann, Mayor

ATTEST:

DocuSigned by:
D57962BD4ECE4A2...

Kristen N. Rosenbaum, City Clerk

DocuSign Envelope ID: 1065DA21-4F20-49E9-A251-29ACAA0362A2

COUNCIL COMMUNICATION

Meeting Date:	Agenda Item:	Agenda Location:	____ 1st Reading ____ 2nd Reading
April 11, 2023	10H	CONSENT CALENDAR	

Subject:
A resolution adopting the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan.

Department Head Review:	Approved by:	Ordinance previously introduced by:
Stephen Kelley, Interim Fire Chief	Kevin S. Woods, City Manager	_____

Presenter(s):
Stephen Kelley, Interim Fire Chief; Ryan Doyle, Emergency Manager

SYNOPSIS:

The 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan (Plan) is an update to the 2017 Council approved Natural Hazard Mitigation Plan, which provides a comprehensive analysis of natural and human-caused hazards which occur in this region. The Plan enables Thornton and our partner cities to have a higher standing and improved chances of receiving funding from Federal and State grants that help with pre-disaster improvements or assist with post-disaster recovery efforts. The Plan has been reviewed by the State of Colorado Division of Homeland Security and Emergency Management (DHSEM) and the Federal Emergency Management Agency (FEMA), which have approved it contingent on adoption by all three cooperating cities.

RECOMMENDATION:

Staff recommends Alternative No. 1, approve the resolution adopting the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan, as presented.

BUDGET/STAFF IMPLICATIONS:

None.

ALTERNATIVES:

1. Approve the resolution adopting the 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan, as presented.
2. Approve the resolution adopting the Plan with changes as directed by City Council.
3. Do not approve the resolution at this time.

BACKGROUND (ANALYSIS/NEXT STEPS/HISTORY): (includes previous City Council action)

The Plan includes the “body,” plus one Annex specific to each of the three partner cities. Each city adopts the body of the plan and the Annex specific to their respective city. This enables each of the three cities to amend the plan in the future without involving the other two cities in the process.

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Background:

April 17, 2017: 2017 Natural Hazard Mitigation Natural Hazard Mitigation Plan approved by Thornton City Council.

April 13, 2021: Thornton City Council approves resolution for an Intergovernmental Agreement (IGA) among the Cities of Thornton, Federal Heights, and Northglenn to conduct a local Natural Hazard Mitigation Plan.

April 20, 2022: 2017 Thornton, Federal Heights, and Northglenn Natural Hazard Mitigation Plan expired.

February 15, 2023: 2023 Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan approved by DHSEM and FEMA, pending formal adoption by respective City Councils.

Next Steps:

Once all three cooperating cities have adopted the Plan, the fully-executed resolutions will be provided to DHSEM and FEMA. FEMA will then issue final approval of the Plan, which will provide the Plan's effective date. The Plan will expire five years after the effective date.

Thornton staff will work toward implementation of the Thornton-specific Mitigation Action Guides and conduct annual reviews and possible updates of the Plan.

ATTACHMENTS:

RESOLUTION NO. 23-10

INTRODUCED BY:
Council Member Jensen
Council Member Arner

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF FEDERAL HEIGHTS, COLORADO, APPROVING A HAZARD MITIGATION PLAN BETWEEN THE CITIES OF FEDERAL HEIGHTS, NORTHGLENN AND THORNTON

WHEREAS, in acknowledgement of the increasing frequency and costs of disasters throughout the nation, in 2017 the cities of Federal Heights, Northglenn and Thornton entered into a Hazard Mitigation Plan ("Plan"); and

WHEREAS, the Plan was the result of the parties community outreach, identification of hazards and risks within their communities, development of mitigation measures and the implementation and maintenance of such measures; and

WHEREAS, given the ever-increasing risks of hazards as demonstrated by COVID, wildfires in neighboring communities, ongoing drought, and cyber-attacks on public entities the parties deemed it necessary to review and update the 2017 Plan; and

WHEREAS, the updated Plan which was completed in 2023 ("2023 Plan") is a comprehensive hazard mitigation strategy which sets forth resources and mitigation measures to reduce the immediate and long-term effects of hazards upon the communities and their governing entities, citizens, businesses, infrastructure, and environments: and

WHEREAS, updating the Plan ensures that the parties remain eligible for Federal Emergency Management Agency ("FEMA") funds, assistance and grants.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF FEDERAL HEIGHTS, COLORADO THAT:

The 2023 Hazard Mitigation Plan between the City of Federal Heights, City of Northglenn and City of Thornton is approved in substantially the same form as the copy attached hereto and made a part of this resolution and the Mayor is authorized to execute the Plan on behalf of the City.

INTRODUCED, READ AND ADOPTED AT A REGULAR MEETING OF THE CITY COUNCIL OF THE CITY OF FEDERAL HEIGHTS, COLORADO, THE 4th DAY OF April 2023.

Linda S. Montoya, Mayor

ATTEST:

Patti K. Lowell, CMC, City Clerk

APPROVED AS TO FORM:

William P. Hayashi, City Attorney

SPONSORED BY: MAYOR LEIGHTY

COUNCIL MEMBER'S RESOLUTION

No. CR-38
Series of 2023

RESOLUTION NO.

23-36
Series of 2023

A RESOLUTION APPROVING THE THORNTON, FEDERAL HEIGHTS, AND NORTHGLENN NATURAL HAZARDS MITIGATION PLAN

WHEREAS, under the Federal Disaster Mitigation Act of 2000, an adopted natural hazards plan is required as a condition of future funding for mitigation projects under Federal Emergency Management Agency (FEMA) pre- and post-disaster grant programs; and

WHEREAS, the Plan has been prepared in accordance with FEMA requirements, Title 44 of the Federal Code of Regulations, part 201.6; and

WHEREAS, Northglenn partnered with the neighboring cities of Thornton and Federal Heights to participate in the drafting of the Plan and entered into an intergovernmental agreement, approved by Resolution No. 21-33 on March 22, 2021 to define the cooperative working relationship among the three cities in regard to the Plan; and

WHEREAS, the Colorado Office of Emergency Management and FEMA have reviewed the Plan and approved it contingent upon adoption by all three cooperating cities.

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

Section 1. The 2023 Thornton, Federal Heights, and Northglenn Natural Hazards Mitigation Plan with Annex C, attached hereto as Exhibit 1, is hereby adopted by the City Council of the City of Northglenn, Colorado.

DATED at Northglenn, Colorado, this 13th day of March, 2023.

Meredith Leighty
MEREDITH LEIGHTY
Mayor

ATTEST:

JOHANNA SMALL, CMC
City Clerk

APPROVED AS TO FORM:

COREY Y. HOFFMANN
City Attorney

U.S. Department of Homeland Security
Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267

FEMA

R8-MT

April 18, 2023

The Honorable Linda S. Montoya
2380 West 90th Avenue
Federal Heights, Colorado 80260

The Honorable Meredith Leighty
11701 Community Center Drive
Northglenn, Colorado 80233

The Honorable Jan Kulmann
9500 Civic Center Drive
Thornton, Colorado 80229

Dear Mayor Montoya, Mayor Leighty, and Mayor Kulmann,

We are pleased to announce the approval of the Thornton, Federal Heights, Northglenn Hazard Mitigation Plan as meeting the requirements of the Stafford Act and Title 44 Code of Federal Regulations 201.6 for a local hazard mitigation plan. The plan approval extends to the Cities of Federal Heights, Northglenn, and Thornton.

The jurisdictions are hereby eligible for FEMA Hazard Mitigation Assistance grant programs. All requests for funding will be evaluated individually according to the specific eligibility and other requirements of the particular programs under which the application is submitted. Approved mitigation plans may be eligible for points under the National Flood Insurance Program Community Rating System.

The plan is approved through April 17, 2028. A local jurisdiction must revise its plan and resubmit it for approval within five years to continue to be eligible for mitigation project grant funding. We have provided recommendations for the next plan update on the enclosed Plan Review Tool.

We wish to thank the jurisdictions for participating in the process and commend your continued commitment to mitigation planning. Please contact Mark Thompson, State Hazard Mitigation Officer, Colorado Division of Homeland Security and Emergency Management at markw.thompson@state.co.us or (720) 630-0770 with any questions on the plan approval or mitigation grant programs.

Sincerely,

Nicole M. Aimone
Acting Mitigation Division Director

Enclosure
cc: Mark Thompson, State Hazard Mitigation Officer, Colorado Division of Homeland Security and Emergency Management

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

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

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Cities of Thornton, Federal Heights, & Northglenn, CO	**Title of Plan:** 2022 Thornton, Federal Heights, & Northglenn Hazard Mitigation Plan	**Date of Plan:** December 2022
Local Point of Contact: Martin Postma	**Address:** City of Thornton 9500 Civic Center Drive Thornton, CO 80229	
Title: Senior Policy Analyst		
Agency: City of Thornton		
Phone Number: 303-538-7631	**E-Mail:** Martin.Postma@thorntonco.gov	

State Reviewer:	**Title:**	**Date:**
Emily Palmer	Hazard Mitigation Planning Specialist	9/16/2022; 1/4/2023

FEMA Reviewer:	**Title:**	**Date:**
Rachael Wolff, IR Rob Pressly, QC	CERC Planner Community Planner	2/3/2023 2/14/2023
Date Received in FEMA Region VIII	**1/12/2023**	
Plan Not Approved		
Plan Approvable Pending Adoption	**2/14/2023**	
Plan Approved	**4/18/2023**	

SECTION 1:
MULTI-JURISDICTION SUMMARY SHEET

MULTI-JURISDICTION SUMMARY SHEET									
#	Jurisdiction Name	Jurisdiction Type	Jurisdiction Contact	Email	Requirements Met (Y/N)				
					A. Planning Process	B. HIRA	C. Mitigation Strategy	D. Update Rqtms.	E. Adoption Resolution
1	City of Thornton	Statutory City	Martin Postma	Martin.Postma@thorntonco.gov	Y	Y	Y	Y	Y
2	City of Federal Heights	Statutory City	Marc Mahoney	mmahoney@fedheights.org	Y	Y	Y	Y	Y
3	City of Northglenn	Statutory City	Becky Smith	bsmith@northglenn.org	Y	Y	Y	Y	Y
4									
5									
6									
7									
8									
9									
10									

SECTION 2:
REGULATION CHECKLIST

REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 2 (p2-6 to 2-15), Annex A (pA-2), Annex B (pB-2), Annex C (pC-2), Appendices B & C	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 2.2 (p2-8 to 2-14); Appendices B & C	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 2.2 (p2-9 to 2-12); Appendices C & D	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 2.2 (p2-13 to 2-14) Appendix F	X	
A5. Is there discussion of how the community (ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 6.3.7 (p6-6), Section 6.4 (p6-6), Annex A.5.3 (pA-50), Annex B.5.3 (pB-24), Annex C.5.3 (pC-23)	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 6.2, (p6-2 to 6-3), Annex A.5 (pA-50), Annex B.5 (pB-24), Annex C.5 (pC-23)	X	
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			

REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 4.1 (p 4-1 to 4-8), Sections 4.3 to 4.17 (p4-17 to 4-158), Annex A.3 (pA-12 to A-23), Annex B.3 (pB-7 to B-16), Annex C.3 (pC-7 to C-16)	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Section 4.1.2 (p 4-2 to 4-6), Sections 4.3 to 4.17 (p4-17 to 4-158), Annex A.3 (pA-12 to A-23), Annex B.3 (pB-7 to B-16), Annex C.3 (pC-7 to C-16)	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Section 4.2 (p 4-8 to 4-16), Sections 4.3 to 4.17 (p4-17 to 4-158), Annex A.3 (pA-12 to A-23), Annex B.3 (pB-7 to B-16), Annex C.3 (pC-7 to C-16)	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Section 4.8.7 (p4-70 to 4-73), Annex A.3.5 (pA-18), Annex B.3.5 (pB-12), Annex C.3.5 (pC-12)	X	
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Section 3.8 (p3-17 to 3-22), Annex A.2.7 (pA-8 to A-12), Annex B.2.7 (pB-4 to B-7), Annex C.2.7 (pC-4 to C-7),	X	

REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 3.8.1 (p3-33 to 3-34); Section 4.8.7 (p4-70 to 4-73), Section 5.2.1 (p5-9), Annex A.2.7 (pA-8), Annex A.3.5 (pA-18), Annex B.2.7 (pB-5), Annex B.3.5 (pB-12), Annex C.2.7 (pC-4), Annex C.3.5 (pC-12)	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 5.1 (p5-1 to 5-2), Annex A.4.1 (pA-28), Annex B.4.1 (pB-19), Annex C.4.1 (pC-19)	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Sections 5.3 and 5.4 (p5-9 to 5-16), Annex A.4.2 (pA-28 to A-49), Annex B.4.2 (pB-19 to B-23), Annex C.4.2 (pC-19 to C-23)	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Sections 5.3 and 5.4 (p5-9 to 5-16), Annex A.4.2 (pA-28 to A-49), Annex B.4.2 (pB-19 to B-23), Annex C.4.2 (pC-19 to C-23)	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 6.3 (p 6-3 to 6-5), Annex A.5.2 (pA-50), Annex B.5.2 (pB-24), Annex C.5.2 (pC-23)	X	
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			

REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 2.1 & 2.2 (p2-1 to 2-15), Section 3.3 to 3.7 (p3-19 to 3-31), Section 4.2 (p4-8 to 4-16), Sections 4.3 to 4.17 (p4-17 to 4-158 "Land Use & Development"), Annex A.2 (pA-4 to A-6), Annex B.2 (pB-2 to B-4), Annex C.2 (pC-2 to C-4)	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section 2.2 (p2-9 & 2-15); Section 5.2 & 5.3 (p5-2 to 5-16), Annex A.4.2 (pA-28), Annex B.4.2 (pB-19), Annex C.4.2 (pC-19)	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 1 (p1-1 to 1-5), Section 2.1 and 2.2 (p2-6 & 2-8), Section 4.1 (Table 4-2, p4-3 to 4-4), Section 5.3 to 5.4 (p5-9 to 5-16), Annex A.1 (pA-2), Annex B.1 (pB-2), Annex C.1 (pC-2)	X	
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))		N/A	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))		X	
ELEMENT E: REQUIRED REVISIONS			

REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
OPTIONAL: HIGH HAZARD POTENTIAL DAM RISKS			
HHPD1. Did Element A4 (planning process) describe the incorporation of existing plans, studies, reports, and technical information for high hazard potential dams?	Section 2.2 (p2-13 to 2-14), Appendix F	x	
HHPD2. Did Element B3 (risk assessment) address HHPDs?	Section 4.4 (p4-22 to 4-28, Section A.3.2 (pA-14), Section C.3.2 (pC-8)	x	
HHPD3. Did Element C3 (mitigation goals) include mitigation goals to reduce long-term vulnerabilities from high hazard potential dams that pose an unacceptable risk to the public?	Section 5.1 (p5-1 to 5-2), Section A.4.1 (pA-28), Section C.4.1 (pC-19)	**x**	
HHPD4. Did Element C4-C5 (mitigation actions) address HHPDs prioritize mitigation actions to reduce vulnerabilities from high hazard potential dams that pose an unacceptable risk to the public?	Table A-9 (Actions TH8, TH11, TH16, TH21, TH24, TH25, TH33, TH41, TH42, TH43, TH67, TH69), Table C-9 (Action NG7)		**x**
REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 3:
PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

Element A: Planning Process

Strengths:

State:

- The plan integrated a 10-step planning process. It included multiple ways to reach out to the public and stakeholders. This led to a wide range of stakeholders, including 155 public survey responses. It was clear that the survey results added to the plan contents and mitigation actions.

FEMA:

- Non-traditional members were on the Hazard Mitigation Planning Committee (HMPC). They represented those who are homeless, elderly, people with disabilities, electric cooperatives;, and others. It is great to see a diverse group participate in the plan, as it can help ensure the inclusion of the voices and needs of the broader community in this growing metro area.
- Appendix B is well documented and lists the membership and attendance of the HMPC. It helps to see which meetings each member could come to. A reader can then connect attendees to the agenda topics in Appendix C and p. 2-9.
- Plan integration is crucial to effective hazard mitigation planning. This plan update looked at 33 plans, studies, or reports, almost half of which (14) were from 2020 or later.
- The City Annexes detail each community in this plan update. A reader can easily learn about their unique histories and current needs. This should shape how the public gets involved.
- It is great to how the plan considers who's vulnerable and at risk in the community, including the understanding that households living in poverty are automatically disadvantaged to hazards (pg. 3-22), and that vulnerability occurs when the system fails individuals (pg. 3-24)
- Table 2-3 *Summary of Key Plans, Studies, and Reports* is a useful table for now just understanding what plans were reviewed but how they were used and where that information can be found. There are a few plans identified in Table 3-7 that would be useful to review including capital improvement plans.

Opportunities for Improvement:

FEMA:

- The third step of the planning process weighed 26 groups. "Many of the agencies participated throughout the planning process in meetings described in Step 1: Organize the Planning Effort" (p. 2-12). Others went to HMPC meetings (i.e., Colorado Division of Homeland Security and Emergency Management). That said, the level of participation for each entity is not clear. Who responded to the invitation? Who asked to stay informed? Who took an active role? For the next plan update please include more detailed information like names in the narrative above the list.
- The three jurisdictions had a strong outreach strategy. To go one step further, the HMPC could segment public survey results by community. This may inform how to rank each community's impactful hazards and mitigation actions.
- The plan does not say how many times Thornton and Federal Heights have met since the 2017 Plan (Annex A.5.1, p. A-50; Annex B.5.1, p. B-24).
- Section 3.7 *Future Population Growth and Development Trends* provides information about the projected population growth for Adams County, but does not address any development trends in the plan's three participating communities. Table 3-7 indicates that all three have a capital improvement plan – how recently were these plans updated, and is there any information on capitol improvement projects that can help inform the communities' development trends?

Element B: Hazard Identification and Risk Assessment

Strengths:

State:

- The plan considers climate change for each profiled hazard. It shows the cascading impacts of the hazards. It also shows how the cities can plan for future disasters.

FEMA:

- The hazard profiles are thorough, and it was great to see the in-depth analysis done for how climate change may impact hazards in the future, how a hazard puts certain populations at risk, and how future development could be impacted by hazards. This kind of analysis will be good to have for the next plan update to meet the new policy requirements around climate change and equity.
- The plan includes great maps that detail how susceptible the jurisdictions are to hazards. The large scale of the maps in the plan annexes makes it easy to see the areas in each jurisdiction that are vulnerable to a given hazard. It helps visually convey risk to property, infrastructure and people.

Opportunities for Improvement:

FEMA:

- For many of the profiled hazards it would be beneficial to include maps that overlay things like zoning codes, affordable housing, future development, etc., with hazard

risk. It can be helpful to visualize risk to help consider how the population and development growth the region is seeing and expected to see will interact with future hazards, which can help the planning team develop effective mitigation strategies to minimize this risk.

Element C: Mitigation Strategy

Strengths:

State:

- The Mitigation Action Plan tables gives valuable detail for the mitigation actions. This makes it clear what each action aims to do.

FEMA:

- Developing the plan's mitigation goals by reviewing the previous plan's goals and working to align them with other plans like the State Mitigation Plan helps ensure the new goals reflect current priorities and integrate with other plans rather than contradict them. Each city having its own goals also allows the community to ensure it is addressing its own hazard risks, vulnerabilities, and capacity. Each community also "owns" how to conduct related actions.
- Table 5-1 *2017 Mitigation Actions Completed or Deleted* was helpful to understand exactly how a project or action was finished, or why it was canceled. Not all of the actions in the table provided this information, though. For the next plan update it will be helpful to include this for all actions where feasible.
- The local mitigation action plans are strong. They tie into the Partner Agencies Mitigation Action Plan and address community needs. For instance, TH45 seeks to use local organizations for messaging. This ties to Goal # Ad Co 6 on public education and awareness.

Opportunities for Improvement:

FEMA:

- The plan notes that members of the planning team considered the categories from the Community Rating System for mitigation actions, in addition to those from the Local Mitigation Planning Handbook. We recommend only using the categories from the Handbook. Categories like Emergency Services may lead members of the planning team to develop strategies that veer more into the response or recovery fields. While it's okay to include response or recovery actions, the planning team will need to ensure the focus lies on mitigation actions. For the next plan update it will be required that at least one mitigation strategy be identified for each hazard profiled in the plan.

- The mitigation strategy tables often reference potential funding opportunities as FEMA or HMA. For the next plan update you will need to be more specific as to the type of grant, e.g., BRIC, FMA, etc.
- While not required, consider developing problem statements that link the HIRA with the Mitigation Strategy that can establish more direct connections between key vulnerabilities with specific mitigation actions. For example, where a mitigation action will address a major issue identified for a hazard, consider adding a footnote or cross-reference to the text noting the relevant Action(s) and/or Action Number(s).
- The plan meets the requirements for addressing NFIP participation in section 5.2.1 *Continued Compliance with NFIP*, and activities like mapping updates suggest future compliance. That said, for the next plan update a more-detailed description that includes specific actions will be beneficial. These could include updates on floodplain ordinances or Risk MAP activities.
- This plan expanded on severe cold weather storms from the previous plan. Their overall significance remains "high", yet there are only a few mitigation actions that address the risk. For the next plan update, encourage additional emphasis on strong mitigation actions for the high-ranking hazards. In Adams County, Medicare beneficiaries rely on electricity for equipment. Federal Heights and Northglenn have a higher percentage of renters and people living in poverty than the state. These populations may be vulnerable to these storms, so it will be critical to develop equitable mitigation strategies that address the risk these vulnerable populations face.
- The City Annexes describe local actions to incorporate the plan. Section 6.3 lists future tools for plan integration. This section may be stronger by referencing specific plans in Thornton, Federal Heights and Northglenn.

Element D: Plan Review, Evaluation, and Implementation (Plan Updates Only)

Strengths:

State:

- The plan does a nice job of explaining what has changed since the last plan update in Section 2.1.1.

FEMA:

- Section 3.6 says that a system, not people, leads to vulnerability (p. 3-24). This is a powerful statement. It is crucial to think about equity in communities in order to develop mitigation strategies that benefit those most at risk – underserved and vulnerable populations. This kind of analysis will be in the policy guidance that will be in effect for the next plan update.

- The plan includes updates to priorities. For instance, the plan looked at public health hazards. While not scored as a typical natural hazard, the HMPC still expanded its planning process with virtual public outreach, which may have helped boost participation.

Opportunities for Improvement:

FEMA:

- The plan addresses future development in the three jurisdictions. The link between development and vulnerability is clear for hazards like swelling soils (p. 4-55) and wildland fire (p. 4-151 to 4-152). "Future Development" in the City Annexes is also specific. That said, it is not clear what has changed since 2017. Try to better connect past and future development to vulnerability. "Before and after" tables or maps may help with this.
- Continued public engagement as written in the plan relies on the public to actively seek out the plan and give feedback. Beyond visiting the city's website to review the plan or discussing it at a public meeting, what are other ways that the planning team could encourage public engagement, such as other public events, townhalls, fairs, or public spaces like libraries?

B. Resources for Implementing Your Approved Plan

FEMA FUNDING SOURCES

Hazard Mitigation Grant Program (HMGP). The HMGP is a post-disaster mitigation program. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements and development of state or local standards. Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to your state and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available. More information: https://www.fema.gov/hazard-mitigation-grant-program

Building Resilient Infrastructure and Communities (BRIC) Grant Program. The BRIC program supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is a new FEMA pre-

disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program. This program provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. For more information, please visit: https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants#hhpd

Flood Mitigation Assistance (FMA) Grant Program. FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is 75 percent. At least 25 percent of the total eligible costs must be provided by a non-federal source. Of this 25 percent, no more than half can be provided as in-kind contributions from third parties. FMA funds are distributed from FEMA to the state. More information: https://www.fema.gov/flood-mitigation-assistance-grant-program

Fire Management Assistance Grant (FMAG) Program. The FMAG program provides grants to states, tribal governments and local governments for the mitigation, management and control of any fire burning on publicly (non-federal) or privately owned forest or grassland that threatens such destruction as would constitute a major disaster. The grants are made in the form of cost sharing with the federal share being 75 percent of total eligible costs. Grant approvals are made within 1 to 72 hours from time of request. More information: http://www.fema.gov/fire-management-assistance-grant-program

Hazard Mitigation Grant Program (HMGP) Post Fire Grant Program. FEMA's Hazard Mitigation Grant Program (HMGP) has Post Fire assistance available to help communities implement hazard mitigation measures after wildfire disasters. States, federally-recognized tribes and territories affected by fires resulting in an Fire Management Assistance Grant (FMAG) declaration on or after October 5, 2018, are eligible to apply. More information: https://www.fema.gov/grants/mitigation/post-fire

Fire Prevention and Safety (FP&S) Grants. FP&S Grants support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to target high-risk populations and reduce injury and prevent death. Eligibility includes fire departments, national, regional, state, and local organizations, Native American tribal organizations, and/or community organizations recognized for their experience and expertise in fire prevention and safety programs

and activities. Private non-profit and public organizations are also eligible. Interested applicants are advised to check the website periodically for announcements of grant availability: https://www.fema.gov/welcome-assistance-firefighters-grant-program

OTHER MITIGATION FUNDING SOURCES

Grant funding is available from a variety of federal and state agencies for training, equipment, and hazard mitigation activities. Several of these programs are described below.

Program 15.228: Wildland Urban Interface Community and Rural Fire Assistance. This program is designed to implement the National Fire Plan and assist communities at risk from catastrophic wildland fires. The program provides grants, technical assistance, and training for community programs that develop local capability, including: Assessment and planning, mitigation activities, and community and homeowner education and action; hazardous fuels reduction activities, including the training, monitoring or maintenance associated with such hazardous fuels reduction activities, on federal land, or on adjacent nonfederal land for activities that mitigate the threat of catastrophic fire to communities and natural resources in high risk areas; and, enhancement of knowledge and fire protection capability of rural fire districts through assistance in education and training, protective clothing and equipment purchase, and mitigation methods on a cost share basis.

Secure Rural Schools and Community Self-Determination Act - Title III- County Funds. The Self-Determination Act has recently been reauthorized and now includes specific language regarding the Firewise Communities program. Counties seeking funding under Title III must use the funds to perform work under the Firewise Communities program. Counties applying for Title III funds to implement Firewise activities can assist in all aspects of a community's recognition process, including conducting or assisting with community assessments, helping the community create an action plan, assisting with an annual Firewise Day, assisting with local wildfire mitigation projects, and communicating with the state liaison and the national program to ensure a smooth application process. Counties that previously used Title III funds for other wildfire preparation activities such as the Fire Safe Councils or similar would be able to carry out many of the same activities as they had before. However, with the new language, counties would be required to show that funds used for these activities were carried out under the Firewise Communities program. For more information, click here.

Community Planning Assistance for Wildfire. Established in 2015 by Headwaters Economics and Wildfire Planning International, Community Planning Assistance for Wildfire (CPAW) works with communities to reduce wildfire risks through improved land use planning. CPAW is a grant-funded program providing communities with professional assistance from foresters, planners, economists and wildfire risk modelers to integrate wildfire mitigation into the development planning process. All services and recommendations are site-specific and come at no cost to the community. More information: http://planningforwildfire.org/what-we-do/

Urban and Community Forestry (UCF) Program. A cooperative program of the U.S. Forest Service that focuses on the stewardship of urban natural resources. With 80 percent of the nation's

population in urban areas, there are strong environmental, social, and economic cases to be made for the conservation of green spaces to guide growth and revitalize city centers and older suburbs. UCF responds to the needs of urban areas by maintaining, restoring, and improving urban forest ecosystems on more than 70 million acres. Through these efforts the program encourages and promotes the creation of healthier, more livable urban environments across the nation. These grant programs are focused on issues and landscapes of national importance and prioritized through state and regional assessments. Information: http://www.fs.fed.us/managing-land/urban-forests/ucf

Western Wildland Urban Interface Grants. The National Fire Plan (NFP) is a long-term strategy for reducing the effects of catastrophic wildfires throughout the nation. The Division of Forestry's NFP Program is implemented within the Division's Fire and Aviation Program through the existing USDA Forest Service, State & Private Forestry, State Fire Assistance Program.

Congress has provided increased funding assistance to states through the U.S. Forest Service State and Private Forestry programs since 2001. The focus of much of this additional funding was mitigating risk in WUI areas. In the West, the State Fire Assistance funding is available and awarded through a competitive process with emphasis on hazard fuel reduction, information and education, and community and homeowner action. This portion of the National Fire Plan was developed to assist interface communities manage the unique hazards they find around them. Long-term solutions to interface challenges require informing and educating people who live in these areas about what they and their local organizations can do to mitigate these hazards.

The 10-Year Comprehensive Strategy focuses on assisting people and communities in the WUI to moderate the threat of catastrophic fire through the four broad goals of improving prevention and suppression, reducing hazardous fuels, restoring fire-adapted ecosystems, and promoting community assistance. The Western States Wildland Urban Interface Grant may be used to apply for financial assistance towards hazardous fuels and educational projects within the four goals of: improved prevention, reduction of hazardous fuels, and restoration of fire-adapted ecosystems and promotion of community assistance. More information: https://www.westernforesters.org/wui-grants

U.S. Fish & Wildlife Service, Rural Fire Assistance Grants. Each year, the U.S. Fish & Wildlife Service (FWS) provides Rural Fire Assistance (RFA) grants to neighboring community fire departments to enhance local wildfire protection, purchase equipment, and train volunteer firefighters. Service fire staff also assist directly with community projects. These efforts reduce the risk to human life and better permit FWS firefighters to interact and work with community fire organizations when fighting wildfires. The Department of the Interior (DOI) receives an appropriated budget each year for an RFA grant program. The maximum award per grant is $20,000. The DOI assistance program targets rural and volunteer fire departments that routinely help fight fire on or near DOI lands. More information: http://www.fws.gov/fire/living_with_fire/rural_fire_assistance.shtml

U.S. Bureau of Land Management, Community Assistance Program. BLM provides funds to communities through assistance agreements to complete mitigation projects, education and

planning within the WUI. More information: https://www.blm.gov/services/financial-assistance-and-grants

NOAA Office of Education Grants. The Office of Education supports formal, informal and non-formal education projects and programs through competitively awarded grants and cooperative agreements to a variety of educational institutions and organizations in the United States. More information: http://www.noaa.gov/office-education/grants

NRCS Environmental Quality Incentives Program (EQIP). The Environmental Quality Incentives Program, administered through the NRCS, is a cost-share program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. Owners of land in agricultural or forest production or persons who are engaged in livestock, agricultural or forest production on eligible land and that have a natural resource concern on that land may apply to participate in EQIP. Eligible land includes cropland, rangeland, pastureland, non-industrial private forestland and other farm or ranch lands. EQUIP is another funding mechanism for landowner fuel reduction projects. More information: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

U.S. Department of Agriculture, Community Facilities Loans and Grants. Provides grants (and loans) to cities, counties, states and other public entities to improve community facilities for essential services to rural residents. Projects can include fire and rescue services; funds have been provided to purchase fire-fighting equipment for rural areas. No match is required. More information: http://www.usda.gov/wps/portal/usda/usdahome?navid=GRANTS_LOANS

General Services Administration, Sale of Federal Surplus Personal Property. This program sells property no longer needed by the federal government. The program provides individuals, businesses and organizations the opportunity to enter competitive bids for purchase of a wide variety of personal property and equipment. Normally, there are no restrictions on the property purchased. More information: http://www.gsa.gov/portal/category/21045

Hazardous Materials Emergency Preparedness Grants. Grant funds are passed through to local emergency management offices and HazMat teams having functional and active LEPC groups. More information: http://www.phmsa.dot.gov/hazmat/grants

U.S. Department of Homeland Security. Enhances the ability of states, local and tribal jurisdictions, and other regional authorities in the preparation, prevention, and response to terrorist attacks and other disasters, by distributing grant funds. Localities can use grants for planning, equipment, training and exercise needs. These grants include, but are not limited to areas of Critical Infrastructure Protection Equipment and Training for First Responders, and Homeland Security Grants.

Community Development Block Grants (CDBG). The U.S. Department of Commerce administers the CDBG program which are intended to provide low and moderate-income households with viable

communities, including decent housing, as suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances, and during the times of "urgent need" (e.g. post disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event. CDBG funds can be used to match FEMA grants. More Information: https://www.hud.gov/program_offices/comm_planning/cdbg

Building Blocks for Sustainable Communities. The EPA Office of Sustainable Communities sometimes offers grants to support activities that improve the quality of development and protect human health and the environment. When these grants are offered, they will always be announced on www.grants.gov. More information: https://www.epa.gov/smartgrowth/building-blocks-sustainable-communities#2016

PUBLICLY AVAILABLE TOOLS

FEMA Community Engagement Prioritization Tool (CEPT).

https://www.fema.gov/floodplain-management/manage-risk/community-engagement-prioritization-tool

FEMA National Risk Index for Natural Hazards (NRI).

https://hazards.geoplatform.gov/portal/apps/MapSeries/index.html?appid=ddf915a24fb24dc8863eed96bc3345f8

FEMA Resilience Analysis and Planning Tool (RAPT).

https://www.fema.gov/emergency-managers/practitioners/resilience-analysis-and-planning-tool

FEMA Flood Assessment Structure Tool (FAST).

https://www.fema.gov/sites/default/files/2020-09/hazus_fast-factsheet.pdf

FEMA HAZUS

https://www.fema.gov/flood-maps/products-tools/hazus

Decision Support System for Water Infrastructure Security (DSS-WISE):

https://dsswiseweb.ncche.olemiss.edu/

CDC/ASTDR Social Vulnerability Index (SVI).

https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

U.S. Census Bureau Community Resilience Estimates

Community Resilience Estimates (census.gov)

OTHER RESOURCES

FEMA: Grant Application Training. Each year, FEMA partners with the State on training courses designed to help communities be more successful in their applications for grants. Contact your State Hazard Mitigation Officer for course offering schedules. Example Courses:

- Unified Hazard Mitigation Grant Assistance Application Development Course
- Benefit Cost Analysis (BCA) Course

FEMA: Community Assistance Visit. It may be appropriate to set up a Community Assistance Visit with FEMA to provide technical assistance to communities in the review and/or updating of their floodplain ordinances to meet the new model ordinance. Consider contacting your State NFIP Coordinator for more information.

FEMA: Building Science. The Building Science branch develops and produces multi-hazard mitigation publications, guidance materials, tools, technical bulletins, and recovery advisories that incorporate the most up-to-date building codes, floodproofing requirements, seismic design standards, and wind design requirements for new construction and the repair of existing buildings. To learn more, visit: https://www.fema.gov/building-science

NOAA/NIDIS: U.S. Drought Portal. NOAA's National Integrated Drought Information System's Drought Portal provides resources for communities to understand their drought conditions, vulnerability, and impacts. The Portal includes data and maps down by city, county, state, zip code, and at watershed global scales. Communities can use this information to inform their hazard mitigation plans with update-to-date data regarding drought conditions, vulnerability, and impacts for sectors such as agriculture, water utilities, energy, and recreation.

EPA: Smart Growth in Small Towns and Rural Communities. EPA has consolidated resources just for small towns and rural communities to help them achieve their goals for growth and development while maintaining their distinctive rural character. To learn more, visit: https://www.epa.gov/smartgrowth/smart-growth-small-towns-and-rural-communities

EPA: *Hazard Mitigation for Natural Disasters: A Starter Guide for Water and Wastewater Utilities.* The EPA released guidance on how to mitigate natural disasters specifically for water and wastewater utilities. For more information, visit: https://www.epa.gov/waterutilityresponse/hazard-mitigation-natural-disasters

National Integrated Drought Information System. The National Drought Resilience Partnership may provide some additional resources and ideas to mitigate drought hazards and increase awareness of

droughts. Visit: https://www.drought.gov/drought/what-nidis/national-drought-resilience-partnership.

STAR Community Rating System. Consider measuring your mitigation success by participating in the STAR Community Rating System. Local leaders can use the STAR Community Rating System to assess how sustainable they are, set goals for moving ahead and measure progress along the way. To get started, go to http://www.starcommunities.org/get-started

Flood Economics. The Economist Intelligence Unit analyzed case studies and state-level mitigation data in order to gain a better understanding of the economic imperatives for investment in flood mitigation. To learn more, visit: http://floodeconomics.com/

Headwaters Economics. Headwaters Economics is an independent, nonprofit research group that works to improve community development and land management decisions in the West. To learn more, visit: https://headwaterseconomics.org/

APPENDIX B: Hazard Mitigation Planning Committee (HMPC)

Jurisdiction/Agency	Title	Name	Meetings Attended
27J Schools - Brighton	Safety and Security Director	Samuel Ortega	1
Adams 12 Five Star Schools	Emergency Preparedness Manager	Angie Wineland	3
Adams County	Emergency Manager	Ronald Sigman	1, 2
Adams County	Senior Long-Range Planner	Libby Tart	1, 2
Adams County Government	Homelessness Coordinator	Lindsey Earl	2
Anythink Libraries	Finance Manager	Nan Fisher	1, 2
Ardent Health and Rehabilitation Center	Administrator	Brad Honl	1
At Growing Home	Advocacy & Community Organizing Coordinator	Isabella Jaramillo	1
Center for People with Disabilities	Community Organizer	Craig Towler	3
City of Federal Heights	Community Development Director	Tim Williams	1
City of Federal Heights	Director of Public Works	Don Stahurski	1
City of Federal Heights	Fire Chief and Emergency Manager	Marc Mahoney	1, 2, 3
City of Northglenn	Environmental Manager	Tami Moon	3
City of Northglenn	Planning Manager	Becky Smith	1, 2, 3
City of Thornton	Active Adult Program Manager	Jessica Romito	3
City of Thornton	Civil Engineer	Rachelle Plas	1, 2
City of Thornton	Contracts & Purchasing Director	Sean Saddler	3
City of Thornton	Floodplain Administrator	Jim Kaiser	1, 2, 3
City of Thornton	GIS Specialist	Margaret Carew	2
City of Thornton	Policy Planner II	Thomas Dimperio	1
City of Thornton	Policy Planning Manager	Glenda Lainis	2
City of Thornton	Senior Policy Analyst	Martin Postma	1, 2, 3
City of Thornton	Utilities Operations Manager	Josh Redman	3
City of Thornton	Water Utility	Emily Hunt	3
City of Westminster	Emergency Manager	Greg Moser	2
Colorado Dept of Homeland Security and Emergency Management	Emergency Management Planner	Irene Merrifield	2
Colorado Dept of Homeland Security and Emergency Management	Mitigation Planning Specialist	Emily Palmer	3
Colorado Dept of Homeland Security and Emergency Management	State Hazard Mitigation Officer	Mark Thompson	1, 2

Jurisdiction/Agency	Title	Name	Meetings Attended
Community Reach Center Thornton	Director of Safety & Emergency Preparedness	Mark Osvirk	1, 3
Cultivando	Executive Director	Olga Gonzalez	2
Denver Regional Council of Governments (DRCOG)	GIS Specialist	Rachel Pierstoff	1, 2, 3
King Adult Day Enrichment Program	Senior Director	Michelle King	3
Metro Water Recovery	Chief Operating Officer	Liam Cavanaugh	1
Mile High Flood District	Watershed Manager	Colin Haggerty	3
Mile High Flood District	Watershed Manager	Dan Hill	1, 2
North Metro Fire Rescue	Emergency Manager	Ross Riley	1
North Suburban Medical Center	Emergency Manager	Ben Tice	1
Regional Transportation District	Environmental Compliance Manager	Mitch Pullam	1, 2, 3
Regional Transportation District	Environmental Compliance Officer	Perry Edman	1
Regional Transportation District	Environmental Specialist	Tara Galanski	1, 2, 3
Regional Transportation District	Transit Safety Specialist	Nathan Marx	1, 2, 3
RockSol Consulting Group	Engineer in Training	Kayla Schultz	2
Shiloh House	Director of Development	Adam Robe	1
Thornton Fire Department	Assistant Chief	Jason Hollands	3
Thornton Fire Department	Deputy Fire Chief	Stephen Kelley	3
Thornton Fire Department	Emergency Manager	Ryan Doyle	1, 2, 3
Thornton Police Department	Division Commander	William Farr	3
Tri-County Health Department	Emergency Preparedness & Response Manager	Sara Garrington	3
Tri-County Health Department	Land Use and Built Environment Specialist	Annemarie Fortune	3
Tri-County Health Department	Nutrition Manager	Judy Fowler	1
United Power	Community Affairs Representative	Tom Green	2, 3
Via Mobility Services	Director of Operations	Lisa Bitzer	1
Wood E&IS Consultant Team	GIS Specialist	Mack Chambers	1, 2
Wood E&IS Consultant Team	Hazard Mitigation Planner	Amy Carr	1, 2, 3
Wood E&IS Consultant Team	Hazard Mitigation Planner	Cameron Nelson	3
Wood E&IS Consultant Team	Hazard Mitigation Planner	Christopher Johnson	1, 2, 3
Wood E&IS Consultant Team	Project Manager	Scott Field	1, 2, 3

APPENDIX C: PLANNING PROCESS DOCUMENTATION

Kickoff Meeting: October 21, 2021

Thornton-Federal Heights-Northglenn Multi-Jurisdictional Hazard Mitigation Plan 2022 Update Kick Off Meeting Agenda

Date: Thursday, October 21, 2021 **Time:** 9:00 – 11:00 am MST

Webinar Link: https://teams.microsoft.com/l/meetup-join/19%3ameeting_MDA3MTE2MGUtYThiZS00ZGNjLWE4ZTUtYTNmNWQ4N2ZjMGUx%40thread.v2/0?context=%7b%22Tid%22%3a%220843acec-fd3e-49be-bd54-18c6048a3fd0%22%2c%22Oid%22%3a%22c66f8855-dc25-4ded-8465-904fcc28db4e%22%7d

Toll-free number: 866-670-1764
Conference ID: 848 999 656#

Project: Thornton-Federal Heights-Northglenn Multi-Jurisdictional Hazard Mitigation Plan Update

Subject/Purpose

The purpose of the meeting is to initiate the process for updating the participating jurisdictions 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.

Attendees: Hazard Mitigation Planning Committee and Stakeholders

1. Introductions
2. Hazard Mitigation Overview
3. Mitigation Planning Process and Requirements
4. Overview of 2017 Hazard Mitigation Plan
5. Coordination with Other Agencies, Related Planning Efforts, & Recent Studies
6. Planning for Public Involvement
7. Project Schedule and Next Steps
8. Questions

wood.

Thornton-Northglenn-Federal Heights, Colorado
Multi-Jurisdictional
Hazard Mitigation Plan 2021 Update

Kick-Off Webinar Summary
Thursday, October 21, 2021
9:00 – 11:00 am MST
Microsoft Teams Virtual Meeting

Introductions and Opening Remarks

This document summarizes the kickoff meeting for the Thornton-Northglenn-Federal Heights Multi-Jurisdictional Hazard Mitigation Plan update in 2021/2022. The meeting was a webinar facilitated by Wood Environment & Infrastructure Solutions, Inc. (Wood), the consulting firm working under a contract with the participating municipalities to facilitate the planning process and develop the updated plan. Martin Postma, Senior Policy Analyst with the City of Thornton, began the meeting with a brief introduction of the plan update. Scott Field, project manager at Wood, then explained the importance of the plan update and thanked everyone for attending. Scott began by asking those attending to virtually introduce themselves by stating their name, title, and agency/jurisdiction using the Chat feature in MS Teams. Thirty-eight (38) persons representing a mix of the consultant team, city departments, school districts, and area stakeholders were present for the meeting.

1. Scott Field, Wood E&IS
2. Christopher Johnson, Wood E&IS
3. Amy Carr, Wood E&IS
4. Becky Smith
5. Jim Kaiser, Floodplain Administrator, City of Thornton
6. Marc Mahoney
7. Martin Postma, Senior Policy Analyst, City of Thornton
8. Rachelle Plas, Civil Engineer, City of Thornton
9. Rachel Pierstorff, GIS Specialist, DRCOG
10. Ryan Doyle
11. Mitch Pullam, RTD Manager Environmental Compliance
12. Mark Osvirk, Director of Safety and Emergency Preparedness, Community Reach Center
13. Tara Glanski, RTD
14. Liza Blitzer, Director of Operations, Via Mobility Services
15. Brad Honl, Administrator Ardent Health and Rehabilitation Center
16. Joann
17. Karla Ramirez
18. Ross Riley, Captain/Emergency Manager, North Metro Fire Rescue
19. Liam Cavanaugh, Metro Water Recovery
20. Ronald Sigman, Adams County OEM
21. Don Stahurski, Public Works Director, City of Federal Heights
22. Ben Tice, North Suburban Medical Center Emergency Manager
23. Tim Williams, Federal Heights Staff

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24. Thomas Dimperio, Policy Planner II, City of Thornton
25. Nan Fisher, Finance Manager, Anythink Libraries
26. Perry Edman, Environmental Compliance Officer, RTD
27. Nathan Marx, Transit Safety Specialist, RTD
28. Mark Thompson, Colorado DHSEM
29. Samuel Oretga, Safety and Security Director, 27J Schools, Brighton
30. Libby Tart, Senior Planner, Adams County Long Range Planning
31. Judy Fowler
32. Dan Hill
33. Danial Filbert
34. Adam Robe, Director of Development, Shiloh House
35. Rocio Franco, Cultivando
36. Isabella Jaramillo
37. 303-933-1393
38. 720-891-1370

Following introductions Scott discussed the agenda items; the key discussion is summarized below, and additional details are within the meeting PowerPoint presentation.

Hazard Mitigation Overview

Mitigation is 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.

Scott (Wood) explained the Disaster Mitigation Act of 2000 which requires having an updated plan in place to ensure the participating jurisdictions are eligible for pre- and post-disaster hazard mitigation grant funds. 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. The COVID-19 Pandemic is a good example of a circumstance that can cause disruption in our community and to the economy. Scott explained we need these plans for several reasons because the reduce future recovery costs, we can plan around predictive events, and they guide mitigation activities in a coordinated manner.

Scott stated there are two main types of benefits a community gains from having a FEMA approved hazard mitigation plan (HMP); (1) bringing people together in the community; (2) having an HMP approved by FEMA makes a community eligible for FEMA grants (Pre-Disaster Mitigation, Flood Mitigation Assistance, Hazard Mitigation Grant Program-Post-Disaster). He noted that any funding requests from FEMA needs to be based on the hazards and mitigation strategy in the HMP. He added that information from the hazard mitigation plan, specifically the vulnerability assessment and mitigation strategy, can be used in other hazard related plans such as emergency operations plans.

Hazard Mitigation Planning Process and Requirements

Scott continued the meeting with the specific planning requirements the cities will have to meet in order to have a FEMA approved plan. Scott reviewed the Disaster Mitigation Act (DMA) of 2000 Requirements and explained that the Thornton-Northglenn-Federal Heights Multi-Jurisdictional Hazard Mitigation Plan (HMP)

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will be updated in accordance with these requirements. The planning process involves a 4 Phase approach with 9 tasks per FEMA guidance updated in 2013. The kickoff meeting is the first step in the process and also covers tasks 1-3 (Determine the planning area and resources; Build the planning team; Create an outreach strategy).

Scott presented a slide with the jurisdictions that are expected to participate in 2021 and will need to re-adopt the plan.

- City of Thornton
- City of Northglenn
- City of Federal Heights

Role of the Hazard Mitigation Planning Committee (HMPC)

The first step in getting organized is to determine the hazard mitigation planning committee members, which has already started with those in attendance at the kickoff meeting. Scott presented a slide with a summary of those invited to be on the committee, based on the previous HMP and input from the participating jurisdictions.

Scott emphasized that local input, and participation from the municipalities and special districts is required for full approval from FEMA. Participation includes the following:

- Attend meetings and participate in the planning process
- Provide requested information to update or develop jurisdictional information
- Review drafts and provide comments
- Identify mitigation projects specific to jurisdiction, provide status
- Assist with and participate in the public input process
- Coordinate formal adoption

Stakeholders include other local, state, and federal agencies with a stake in hazard mitigation in the planning area or may include academic institutions and local business and industry. Neighboring jurisdictions and counties were also notified about the update and will be given an opportunity to provide input into the process. Stakeholders have various options and levels of participation including:

- Attend HMPC meetings or stay in loop via email list
- Provide data/information
- Partner on mitigation efforts
- Review draft plan

Plan Update Requirements, Key Elements and Schedule

Aspects of the planning process include:

- Engage the participants to take part in planning process and efforts
- Raise awareness and engage the public
- Update hazards and baseline development data to reflect current conditions
- Update the mitigation strategy

wood.

- Document progress and note changes in priorities

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 Thornton-Northglenn-Federal Heights Hazard Mitigation Plan (2017) providing the baseline for identified hazards and the groundwork for goals, policies, and actions for hazard mitigation.

The HMP will be updated over the next six months, with at least two more meetings with the Hazard Mitigation Planning Committee. Wood will be updating the Hazard Identification and Risk Assessment (HIRA) in the next couple of months, with input from the HMPC. Three drafts of the HMP will be created: the first for review by HMPC committee, a second for public review, and a third for state and FEMA review. The first draft for HMPC review is targeted for December 2021, a public review draft in February 2022, followed by a review by Colorado DHSEM in March 2022 and then tentatively approved by FEMA in April 2022.

Review of Identified Hazards

Based on hazards from the 2017 HMP, the list of potential hazards was reviewed. Scott showed a slide that listed the hazards in the 2017 HMP, as follows:

- Drought
- Earthquake
- Expansive Soils/Undermined Areas
- Extreme Temperatures
- Flood
- Severe Storms
- Public Health Hazards
- Tornado/Severe Wind
- Winter Storm
- Wildland Fire

The group thought that the original list of hazards was still valid although there was discussion that the levels of significance may have changed since 2017. Scott showed a slide of how the hazards were ranked by significance in the 2017 plan. There will be more detail provided on methodology during the next meeting. Additional comments made during the presentation are noted in the meeting chat log. The original list of hazards will be carried forward in the 2022 update, however several new hazards will also be profiled, listed below:

- Dam/Levee Incident
- Solar Storms
- Hazardous Materials
- Terrorism/Active Shooter
- Cyber Attack
- Mass Transportation Accident
- Invasive Species

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- Water Supply Contamination

Scott noted that every hazard profiled must have at least one mitigation action identified, and each jurisdiction will need at least one new action added to the updated plan.

Scott asked the group to review the list of hazards and comment on how they could be enhanced or updated with:

- Historic incidents
- Incident logs
- Public perception
- Scientific studies
- Other plans and reports (e.g., flood and drainage studies, incident damage assessments, Internet databases)
- Recent disasters

Coordinating with Other Agencies/Related Planning Efforts/Recent Studies

A discussion on recent studies of hazards in other documents and reports followed the identified hazards discussion. Opportunities for coordinating and cross-referencing the HMP were discussed. The group noted that Mile High Flood District has multiple drainage master plans for this area that could be referenced. Becky Smith also provided a link to the City of Northglenn's water quality report.

Planning for Public and Stakeholder Involvement

Scott noted that a Public survey will be developed to gather input from the public on hazard concerns and mitigation ideas. Advertisement of public survey will be through public information channels, official websites, social media, email blasts etc. He asked for opportunities for outreach at scheduled public meetings or events. Suggestions included discussing the HMP update at City Council and County Commission meetings.

Scott asked for ideas on additional stakeholders to be made aware of the plan update effort. Hyland Hills Park and Recreation District was suggested by the group.

Initial Information Needs and Next steps

Scott discussed a slide with initial information needs and next steps. Scott encouraged the group to send by email information on:

- Recent hazard events (since 2017) – damages, incident logs, damage assessments, etc.
- Growth and development trends
- Recent updated plans and policies
- GIS Data

Where available online, Wood will try to obtain the updated plans previously noted. Scott encouraged the group to send other information that might not be readily accessible online.

A GIS needs list was provided to the participating jurisdictions to assist with data collection, which is already in progress. The participating jurisdictions will provide the meeting summary, handouts, presentation, and

wood.

sign in sheet by email so that other HMPC members that could not attend today's meeting could get up to speed. Wood 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.

Adjourn

The meeting adjourned at 11:05 am MT.

Attachments:

MS Teams Meeting chat log

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Attachment: **Thornton-Northglenn-Federal Heights Hazard Mitigation Plan Update**

Kickoff Meeting Chat Log

[10/21/2021 8:26 AM]
10/21/2021 8:26 AM Meeting started
[10/21/2021 8:43 AM]
Martin Postma (External) has temporarily joined the chat.
[10/21/2021 8:43 AM]
Jim Kaiser (External) has temporarily joined the chat.
[10/21/2021 8:43 AM]
Marc Mahoney (External) has temporarily joined the chat.
[10/21/2021 8:44 AM]
Becky Smith (Guest) has temporarily joined the chat.
[10/21/2021 8:46 AM]
Rachelle Plas (External) has temporarily joined the chat.
[10/21/2021 8:51 AM]
Ryan Doyle (External) has temporarily joined the chat.
[10/21/2021 8:55 AM]
Mitch Pullam (External) has temporarily joined the chat.
[10/21/2021 8:56 AM]
Unknown user has temporarily joined the chat.
[10/21/2021 8:56 AM]
Tara Galanski (External) has temporarily joined the chat.
[10/21/2021 8:56 AM]
Lisa Bitzer (External) has temporarily joined the chat.
[10/21/2021 8:58 AM]
Brad Honl has temporarily joined the chat.
[10/21/2021 8:58 AM]
Joann (Guest) has temporarily joined the chat.
[10/21/2021 8:59 AM]
Ross Riley has temporarily joined the chat.
[10/21/2021 8:59 AM]
Karla Ramirez (Guest) has temporarily joined the chat.
[10/21/2021 8:59 AM]
Cavanaugh, Liam has temporarily joined the chat.
[10/21/2021 9:00 AM]
Don Stahurski has temporarily joined the chat.
[10/21/2021 9:00 AM]
Nathan Marx has temporarily joined the chat.
[10/21/2021 9:00 AM]
Ronald Sigman (External) has temporarily joined the chat.
[10/21/2021 9:00 AM]
Rachel Pierstorff has temporarily joined the chat.
[10/21/2021 9:01 AM]
Thomas Dimperio has temporarily joined the chat.
[10/21/2021 9:01 AM]
Ben Tice- North Suburban MC (Guest) has temporarily joined the chat.
[10/21/2021 9:01 AM]
Tim Williams has temporarily joined the chat.
[10/21/2021 9:01 AM]
Mark Thompson (Guest) has temporarily joined the chat.
[10/21/2021 9:01 AM]

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Samuel Ortega has temporarily joined the chat.
[10/21/2021 9:02 AM]
Libby Tart has temporarily joined the chat.
[10/21/2021 9:02 AM]
Judy Fowler (Guest) has temporarily joined the chat.
[10/21/2021 9:02 AM]
Dan Hill has temporarily joined the chat.
[10/21/2021 9:04 AM]
Daniel Filbert has temporarily joined the chat.
[10/21/2021 9:06 AM]
Ben Tice- North Suburban MC (Guest) no longer has access to the chat.
[10/21/2021 9:07 AM]
Ben Tice- North Suburban MC (Guest) has temporarily joined the chat.
[10/21/2021 9:07 AM]
Nan Fisher has temporarily joined the chat.
[10/21/2021 9:07 AM]
Perry Edman has temporarily joined the chat.
[10/21/2021 9:10 AM] Mark Thompson (Guest)
Mark Thompson, State Hazard Mitigation Officer, DHSEM

[10/21/2021 9:10 AM] Mark Thompson (Guest)
Mark Thompson, State Hazard Mitigation Officer, DHSEM

[10/21/2021 9:10 AM] Lisa Bitzer
Lisa Bitzer, Director of Operations at Via Mobility Services

[10/21/2021 9:10 AM] Ronald Sigman
Ron Sigman - Adams County Emergency Manager 720.523.6601

[10/21/2021 9:10 AM] Tara Galanski
Tara Galanski - RTD

[10/21/2021 9:10 AM] Martin Postma
Martin Postma, Senior Policy Analyst, City of Thornton

[10/21/2021 9:10 AM] Rachel Pierstorff
Rachel Pierstorff, GIS Specialist, DRCOG

[10/21/2021 9:10 AM] Brad Honl
Brad Honl, Administrator Ardent Health and Rehabilitation Center, Thornton

[10/21/2021 9:10 AM] Dan Hill
Dan Hill, Watershed Manager, Mile High Flood District (Colin Haggerty will also be involved in this effort but is unavailable today)

[10/21/2021 9:10 AM] Rachelle Plas
Rachelle Plas, Civil Engineer, City of Thornton

[10/21/2021 9:10 AM] Nathan Marx
Nathan Marx - Transit Safety Specialist at RTD

[10/21/2021 9:10 AM] Libby Tart
Libby Tart, Senior Long Range Planner with Adams County

wood.

[10/21/2021 9:10 AM] Osvirk, Mark
Mark Osvirk

[10/21/2021 9:10 AM] Perry Edman
Perry Edman, Environmental Compliance Officer, Regional Transportation District (RTD)

[10/21/2021 9:10 AM] Don Stahurski
Don Stahurski - City of Federal Heights - Public Works Director

[10/21/2021 9:10 AM] Tim Williams
Tim Williams, Federal Heights Staff

[10/21/2021 9:10 AM] Samuel Ortega
Sam Ortega, Safety and Security Director, 27J Schools, Brighton

[10/21/2021 9:10 AM] Cavanaugh, Liam
Liam Cavanaugh - Metro Water Recovery

[10/21/2021 9:11 AM]
Adam (Guest) has temporarily joined the chat.

[10/21/2021 9:11 AM] Ben Tice- North Suburban MC
Ben Tice- North Suburban Medical Center Emergency Manager

[10/21/2021 9:11 AM] Thomas Dimperio
Thomas Dimperio, Policy Planner II, City of Thornton

[10/21/2021 9:11 AM] Ross Riley
Captain Ross Riley, Emergency Manager, North Metro Fire Rescue, we provide fire protection, EMS, Haz-Mat and Technical Rescue to the City of Northglenn.

[10/21/2021 9:11 AM] Osvirk, Mark
Mark Osvirk Community Reach Center Thornton

[10/21/2021 9:11 AM] Adam (Guest)
Adam Robe, Director of Development Shiloh House

[10/21/2021 9:11 AM] Jim Kaiser
Jim Kaiser, City of Thornton Floodplain Administrator

[10/21/2021 9:12 AM] Nan Fisher
Nan Fisher, Finance Manager Anythink Libraries

[10/21/2021 9:12 AM] Mitch Pullam
Mitch Pullam - RTD Manager, Environmental Compliance

[10/21/2021 9:17 AM] Jim Kaiser
Will slides be provided with the meeting minutes?

[10/21/2021 9:19 AM] Carr, Amy
Yes, the slides, meeting summary and recording will all be provided after the meeting.

[10/21/2021 9:29 AM] Ryan Doyle
Ryan Doyle, Emergency Manager Thornton Fire Department

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[10/21/2021 9:33 AM] Don Stahurski
Hyland Hills Parks & Rec District may be a potential stakeholder
like 1

[10/21/2021 9:57 AM] Osvirk, Mark
Team, I am new to these meetings and Director of Safety and Emergency Preparedness role at Community Reach Center. I ask that all current and future correspondence be sent to my email address at m.osvirk@communityreachcenter.org Thanks

[10/21/2021 9:57 AM]
Geoff Mills (Guest) has temporarily joined the chat.

[10/21/2021 9:59 AM] Martin Postma
Thanks Mark. I will update the list with your email.

[10/21/2021 9:59 AM] Isabella Jaramillo
Hello! I'm new to these as well- Isabella jaramillo - advocacy and community organizing coordinator, At Growing Home
Isa@growinghome.org

[10/21/2021 10:03 AM] Martin Postma
Thanks Isabella. I will add your contact to the list as well.

[10/21/2021 10:06 AM] Nan Fisher
Please add myself to the email list. Nan Fisher, Finance Manager Anythink Libraries

[10/21/2021 10:07 AM] Lisa Bitzer
Being new to this group as well. Please add my email as Lbitzer@viacolorado.org. Via would be very interested in being a stakeholder. We can provide transportation to move people when needed. Thanks

[10/21/2021 10:12 AM] Dan Hill
MHFD has multiple drainage Master Plans for this area available through our website, typically organized by watershed.
like 1

[10/21/2021 10:15 AM] Becky Smith (Guest)
Not sure if we sent this water quality report before?
https://northglenn.org/Government/departments/Water/NORTHGLENN_CO0101115_2017CCR.pdf

[10/21/2021 10:18 AM] Rocio Franco
Hello, I would like to be added to the list - Rocio Franco , Cultivando / rocio@cultivando.org

[10/21/2021 10:20 AM] Becky Smith (Guest)
Also, I know our Water Administrator recently completed at an Integrated Water Resources Plan (IWRP) and Water Efficiency Plan (WEP). Let me know if these documents would be helpful to you and I can get you in touch with them

[10/21/2021 10:24 AM] Martin Postma
Thanks Rocio. I will add you to the list.

[10/21/2021 10:25 AM] Martin Postma
Thanks Becky. Those documents would be useful.

wood.

[10/21/2021 10:26 AM] Martin Postma
Thank you, Lisa. I have added you to the list.

[10/21/2021 10:27 AM] Martin Postma
Thank you Nan. Please provide your email address.

[10/21/2021 10:28 AM] Nan Fisher
nfisher@anythinklibraries.org please add

[10/21/2021 10:28 AM] Nathan Marx
Please add me to the email list - nathan.marx@rtd-denver.com

[10/21/2021 10:28 AM] Samuel Ortega
sortega@sd27j.net

[10/21/2021 10:29 AM] Martin Postma
Thanks Nan , Nathan, and Samuel.

[10/21/2021 10:35 AM] Dan Hill
Please add dhill@mhfd.org and chaggerty@mhfd.org as well. Thank you!

[10/21/2021 10:35 AM] Libby Tart
Thanks so much all! Please let us know if you need any updated AdCO GIS data! ltart@adcogov.org

[10/21/2021 10:35 AM] Becky Smith (Guest)
Thank you!

[10/21/2021 10:35 AM] Rocio Franco
Thank you!

[10/21/2021 10:35 AM] Chambers, Mack
Thank you Libby I will reach out as needed.

[10/21/2021 10:35 AM]
Unknown user no longer has access to the chat.

[10/21/2021 10:35 AM] Ryan Doyle
Thanks!

[10/21/2021 10:35 AM] Mitch Pullam
Thanks!

Meeting ended 2h 39m 11:05 AM
2h 39m
Meeting Recorded by: Field, Scott

Risk Assessment Meeting: December 8, 2021

Federal Heights, Northglenn & Thornton Hazard Mitigation Plan Update Stakeholder Meeting #2 Agenda

Date: Wednesday, December 8, 2021
2:30 – 4:30 pm MST

Meeting at: Microsoft Teams meeting
Click here to join the meeting
https://bit.ly/3CKykpd
1-281-810-1627 or
1-(866)-670-1764 (Toll-free)
Conference ID: 727 814 251#

Subject/Purpose: The purpose of the meeting is to review the updated Hazard Identification and Risk Assessment portion of the Hazard Mitigation Plan.

Attendees: Hazard Mitigation Planning Committee and Stakeholders

1. Introductions
2. Review of the hazard mitigation planning process
3. Update on public involvement activities
4. Plan update guide
5. Review of hazards and vulnerability assessment update
6. Updating mitigation goals
7. Next steps
8. Questions and answers

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Thornton-Federal Heights-Northglenn, Colorado
2021-2022 Multi-Jurisdictional Hazard Mitigation Plan Update

Risk Assessment Meeting Summary
December 8, 2021; 2:30-4:30 pm MT

Subject/Purpose

This document summarizes the risk assessment meeting held for the Thornton-Federal Heights-Northglenn Multi-Jurisdictional Hazard Mitigation Plan (HMP) 2021-2022 update. The meeting was conducted by Wood Environment & Infrastructure Solutions, Inc. (Wood), 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 update to the Hazard Identification and Risk Assessment and revisit the plan's goals. This meeting was delivered as a virtual web meeting via Zoom. Scott Field, Project Manager at Wood, began the meeting with introductions. 32 individuals attended the meeting representing a mix of the consultant team, city department representatives, and various stakeholders.

Attendees

- Hazard Mitigation Planning Committee
- 32 people attended including:
    1. Martin Postma – City of Thornton
    2. Marc Mahoney - City of Federal Heights
    3. Becky Smith - City of Northglenn
    4. Ryan Doyle - Thornton Fire Emergency Manager
    5. Nan Fisher - Anythink Libraries Finance Manager
    6. Tara Galanski - RTD Environmental Transit Specialist
    7. Lindsey Earl - Homelessness Coordinator Adams County CSWB
    8. Mitch Pullam - RTD Manager Environmental Compliance
    9. Margaret Carew - GIS Analyst City of Thornton
    10. Jim Kaiser - Floodplain Administrator, Infrastructure Engineering Director, Thornton
    11. Kayla Schultz - EIT Rock Sol Consulting
    12. Nathan Marx - Transit Safety RTD
    13. Mark Osvirk - Director of Facilities Community Reach Center
    14. Greg Moser - Westminster EMC
    15. Rachelle Plas - Civil Engineer, Thornton
    16. Mark Thompson - DHSEM SHMO
    17. Emily Palmer - DHSEM, Mitigation Planning Specialist
    18. Irene Merrifield - DHSEM Mitigation Planning Supervisor
    19. Colin Haggerty - Mile High Flood District
    20. Dan Hill – Mile High Flood District
    21. Jesseri Jensen - Civil Engineering Associate, RockSol Consulting
    22. Olga Gonzalez - Cultivando Executive Director

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23. Rocio Franco - Associate Director Cultivando
24. Rachel Pierstorff - GIS Specialist DRCOG
25. Glenda Lainis - Policy Planning Manager Thornton
26. Kyle Mason - Broomfield Emergency Manager
27. Ronald Sigman - Adams County OEM
28. Unknown 303-408-2488
29. Amy Carr, Wood E&IS
30. Christopher Johnson, Wood E&IS
31. Mack Chambers, Wood E&IS
32. Scott Field, Wood E&IS

Introductory Remarks/Review of the planning process
Following introductions, Scott Field reviewed the planning process being followed and discussed the project status and progress made thus far. Highlights include:

- Kickoff meeting October 21, 2021
- GIS analysis and map updates ongoing
- Risk assessment update in progress
- Plan Update Guide introduced – please return by January 17th, 2022

Scott also gave a brief overview of the plan update guides which are being sent out to the participating jurisdictions. Scott also provided an update of forthcoming public engagement activities, including a project website and upcoming public opinion survey.

Review of identified hazards and vulnerability assessment update highlights
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 and Problem Statements
Flooding	• Jim Kaiser - structure exposure data. Recently completed MHFD Niver Creek basin flood delineation recently completed. Mapped a fair number of structures in Thornton that were previously unmapped. Doing a mitigation project right now to keep those structures out. Fair number of mobile homes added in. Some modification in FH but not adverse changes. Thornton parkway and Pecos on the tributary end of the Niver Creek. Full Flood Hazard Delineation by MHFD. • Dan Hill - Thanks for mentioning the recently completed plan. We can provide to Wood with a link to our website. It will be designated by CWCB in the coming months.

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Hazard or Topic	Meeting Discussion and Problem Statements
	• Rachelle - for CRS they do overlay with floodplain and structures. They have 44 structures. Would like to compare with Wood GIS data re: buildings vs. parcels.
Dam Failure/Incident	• Martin - True area of study includes all 3 cities and growth area. Does this account the people that are in the growth area? • Mack - these numbers do not consider the growth areas. Will be included in the plan • Scott – for analysis treating it as a separate jurisdiction. • Becky - noted that Section 36 in NG has some dam inundation. Mostly AG land right now. • Greg Moser - dam inundation data from Westminster that could spill over to their areas.
Earthquake	• Ryan Dole - does Hazus dial in for type of buildings? Wood vs brick? Noted that some of the critical infrastructure is brick. • Mack - noted that if they are fortified (reinforced masonry) can go into Hazus and edit those. • Jim Kaiser - one thing on building types. A lot of buildings multifamily, commercial, hotels that look like masonry are actually just facades not really brick. More of a fire danger than earthquake danger.
Expansive Soils/Undermined Areas	• Jim Kaiser - for structures built recently spent money on mitigation due to expansive soils. Thinks moderate hazard for Thornton. But as Chris noted will be individual property (case by case) situation.
Drought and Extreme Heat	• Martin - in regard to agriculture, is that within planning area or broader? • Scott - data just showing county level data. But noted that regional impacts of drought. • Jim Kaiser - caution about drawing conclusions in Adams County. Where 3 cities are located is more on the transition of foothills not the eastern plains.
Wildfire	• No Comments
Severe Warm Weather	• No Comments
Tornado	• No Comments
Severe Cold Weather	• Marc - in FH we've had a couple years now of heavy blizzards. This has significant impacts on resources. Opened city hall as temporary shelter. • Ryan Doyle - any incidents that are not statewide declarations but other events that were more local impacts. Bomb cyclone (2019) • Ron Sigman - March 2019 was a declared disaster for county.

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Hazard or Topic	Meeting Discussion and Problem Statements
	• Jim Kaiser - timing of storms is going to relate to what the damage is. Class 3 level storm mobilize contractors. 8 inches trigger on that. Decent plan from Street Group. (capability). "Mother's Day Storm" 2004/2005 (Spring storms common) significant amount of debris to clean up • Ron Sigman - On severe weather, a major consideration that continues to get worse is people experiencing homelessness. Not only snow events but even low temps require activation of shelters, severe weather plans, etc... So the impact can be high even if the event is only impacting a small percentage of the total population.
Public Health	• No Comments
HazMat	• Martin - question on what unknown sheen is. • Jim Kaiser - Medium or High for Thornton. Petroleum pipelines. North areas that are building out there are active and abandoned wells. Unmapped flow lines. • Martin - noted major highways and different business types in city. • Greg - several major pipelines in or near these communities
Transportation Incident	• Martin – High significance due to highways and auto transportation
Cyber Threats	• Mark Thompson - limited IT capability to fight ransomware • Martin - can engage Thornton IT director about cyber threats and mitigation.
Terrorism	• Olga -Cultivando working with OES with Active Shooter. One that many communities are concerned about asking for more information on response and the aftermath of events
Ground and Surface Water Supply Contamination	• Ryan Dole - potential e.coli scenarios. Maybe 3 a year. But do they become full blown and reported to Tri-County health...no. water sources along 85. hazmat spill or someone just pouring chemical in reservoir on 104th. Water Resources folks are aware of and can connect Wood with. • Ron Sigman - Ryan, you can also check with Glenn at the Hazmat Authority to get some additional info. • Greg - CDPHE sometimes shares data to local health depts. CDOT has information on spills. • Mark Thompson - hard to integrate in HIRA usually a consequence. May consider that within the other hazard sections

Review of Mitigation Goals

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Scott led a brief discussion on the mitigation goals from the previous plan; the Plan Update Guide will include a space for suggestions on any changes or updates to these goals. They can be adopted as is if the group still feels they are relevant. Mark Thompson suggested that the group find ways to reference/integrate FEMA lifelines in the goals and objectives.

Next Steps/Adjourn
The project schedule was reviewed:

Project Milestone	**Anticipated Timeline**
• Public Survey	December-January
• Updated HIRA	January
• HMPC Meeting #3	January
• HMPC Review Draft	February
• Public Review Draft	Early March
• CO DHSEM Review	Late March
• Final Plan for FEMA Review (estimated)	April-May
• Final Approved HMP for local adoption	May 2022

Next steps were discussed, including the following:

- Complete and return the Plan Update Guide
  - Including status of 2017 mitigation actions
- Help publicize the public survey & website when released
- Stay informed by email of upcoming meetings
- Draft HIRA for HMPC review coming soon

Adjourn

The meeting adjourned at 4:40 pm

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Thornton-Federal Heights-Northglenn Hazard Mitigation Plan Update
Risk Assessment Meeting Chat Log

[12/8/2021 2:37 PM] Lindsey Earl

Lindsey Earl, Homelessness Coordinator, Adams County CSWB

[12/8/2021 2:37 PM] Nan Fisher

Nan Fisher Anythink Libraries Finance Manager

[12/8/2021 2:37 PM] Colin Haggerty

Colin Haggerty, Mile High Flood District

[12/8/2021 2:37 PM] Dan Hill

Dan Hill, Mile High Flood District

[12/8/2021 2:37 PM] Olga Gonzalez (Guest)

Olga Gonzalez-Cultivando, Executive Director

[12/8/2021 2:37 PM] Nathan Marx

Nathan Marx - Transit Safety Specialist - RTD

[12/8/2021 2:37 PM] Tara Galanski

Tara Galanski, RTD, Environmental Transit Specialist

[12/8/2021 2:37 PM] Irene Merrifield - DHSEM (Guest)

Irene Merrifield, DHSEM Mitigation Planning Supervisor

[12/8/2021 2:37 PM] Kayla Schultz

Kayla Schultz, EIT, RockSol Consulting

[12/8/2021 2:37 PM] Ryan Doyle

Ryan Doyle, Thornton Fire Emergency Manager

[12/8/2021 2:37 PM] Jim Kaiser

Jim Kaiser, Floodplain Administrator, Infrastructure Engineering Director, City of Thornton

[12/8/2021 2:37 PM] Rocio Franco

Rocio Franco, Associate Director - Cultivando

[12/8/2021 2:37 PM] Jesseri Jensen

Jesseri Jensen, Civil Engineering Associate, RockSol Consulting

[12/8/2021 2:37 PM] Margaret Carew

Margaret Carew GIS Analyst for the City of Thornton

[12/8/2021 2:37 PM] Mitch Pullam

Mitch Pullam - RTD - Manager, Environmental Compliance

[12/8/2021 2:37 PM] Rachelle Plas

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Rachelle Plas, City of Thornton, Civil Engineer

[12/8/2021 2:38 PM] Rachel Pierstorff

Rachel Pierstorff, GIS Specialist, DRCOG

[12/8/2021 2:38 PM] Osvirk, Mark

Mark Osvirk, Director of Facilities and Safety, Community Reach Center

[12/8/2021 2:39 PM] Glenda Lainis (Guest)

Glenda Lainis, Policy Planning Manager, City of Thornton

[12/8/2021 2:40 PM] Johnson, Christopher A

Christopher Johnson, Hazard Mitigation Planner/GIS Specialist, Wood

[12/8/2021 2:40 PM] Mark Thompson (Guest)

I see several reps from RTD. Any plans they have for these cities would be good.

[12/8/2021 2:41 PM]

Ronald Sigman (External) has temporarily joined the chat.

[12/8/2021 2:43 PM] Irene Merrifield - DHSEM (Guest)

Emily Palmer, DHSEM Mitigation Planning Specialist

[12/8/2021 2:53 PM]

Colin Haggerty no longer has access to the chat.

[12/8/2021 2:56 PM]

Becky Smith (Guest) has temporarily joined the chat.

[12/8/2021 3:02 PM] Tara Galanski

Mark Thompson are there any kind of plans in particular you are looking for? Just hazard mitigation?

[12/8/2021 3:11 PM] Field, Scott

Mark Thompson are there any kind of plans in particular you are looking for? Just hazard mitigation?

Anything pertaining to the hazards we're coving or mitigation actions against them.

like 2

[12/8/2021 3:15 PM] Mark Thompson (Guest)

Tara, an example would be any RTD plans for expansion or changes in the three cities so those plans can be overlaid on the hazard maps.

like 1

[12/8/2021 3:21 PM] Becky Smith (Guest)

It does look like Section 36 in NG has some dam inundation

like 1

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[12/8/2021 3:21 PM] Becky Smith (Guest)

Yes, it's mostly AG

[12/8/2021 3:36 PM] Mitch Pullam

We should be able to contribute our Program Description Document (PDD) for our MS4 stormwater permit that includes the N-Line. We will discuss/track down other plans that may help. mitchell.pullam@rtd-denver.com

[12/8/2021 4:06 PM] Ronald Sigman

On severe weather, a major consideration that continues to get worse is people experiencing homelessness. Not only snow events but even low temps require activation of shelters, severe weather plans, etc... so the impact can be high even if the event is only impacting a small percentage of the total population.

[12/8/2021 4:15 PM] Dan Hill

Johnson, Christopher A (Guest), Chambers, Mack - I just sent the recently completed Niver Creek floodplain study by MHFD to Scott. Please ask him to forward to you as I don't have your email addresses. Thanks!

heart 1

[12/8/2021 4:15 PM] Chambers, Mack

Thank you Dan!

like 1

[12/8/2021 4:17 PM] Mark Thompson (Guest)

Or the limited IT capability to fight ransomware.

[12/8/2021 4:28 PM] Ronald Sigman

Ryan, you can also check with Glenn at the Hazmat Authority to get some additional info.

[12/8/2021 4:34 PM]

Rachel Pierstorff no longer has access to the chat.

[12/8/2021 4:36 PM] Moser, Greg

You folks also have several major pipelines in or near these communities. I had to step away, so this may have been mentioned.

[12/8/2021 4:36 PM] Becky Smith (Guest)

Thanks everyone. Good discussion.

[12/8/2021 4:37 PM]

Olga Gonzalez (Guest) no longer has access to the chat.

[12/8/2021 4:37 PM]

Dan Hill no longer has access to the chat.

[12/8/2021 4:37 PM] Margaret Carew

Thank you!

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[12/8/2021 4:37 PM]
Becky Smith (Guest) no longer has access to the chat.
[12/8/2021 4:37 PM]
Irene Merrifield - DHSEM (Guest) no longer has access to the chat.
[12/8/2021 4:37 PM]
Mark Thompson (Guest) no longer has access to the chat.
[12/8/2021 4:38 PM]
Emily Palmer, DHSEM (Guest) no longer has access to the chat.
[12/8/2021 4:40 PM]
12/8/2021 4:40 PM Meeting ended: 2h 21m 37s

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Hazard Survey Results, Risk Assessment Meeting

City	Drought	Earthquake	Expansive Soils / Undermined Areas	Extreme Temperatures	Flood	Severe Storms	Public Health Hazard	Tornado / Severe Wind	Winter Storm	Wildland Fire
City of Thornton	High	Low	Medium	Low	High	High	Medium	High	High	Low
City of Federal Heights	Medium	Low	Low	Medium	High	Medium	High	High	High	Low
City of Northglenn	High	Low	Low	Medium	High	High	Low	Medium	High	Medium

Mitigation Strategy Meeting: March 3, 2022

Thornton, Federal Heights, Northglenn 2022 Hazard Mitigation Plan Update Mitigation Strategy Meeting Agenda

Date: Thursday, March 3, 2022, 9 am – 11 am MST

Meeting at: https://teams.microsoft.com/l/meetup-join/19%3ameeting_NTAzOTBiOGUtMWMwMC00OWI4LTg0MzMtNDkzZDFkZGIyOWFh%40thread.v2/0?context=%7b%22Tid%22%3a%220843acec-fd3e-49be-bd54-18c6048a3fd0%22%2c%22Oid%22%3a%221af7d331-902d-4752-9987-ea455d99ec99%22%7d

Or Call In
(866) 670-1764

Conference ID:
559 039 670#

Subject/Purpose

This meeting will focus on updating the plan's mitigation strategy, including the plan's goals and objectives, actions undertaken since the last plan update, and identifying new mitigation activities. All participating jurisdictions and planning team members are encouraged to attend. The meeting will be conducted virtually using Microsoft Teams due to the COVID-19 pandemic and social distancing requirements.

Attendees: Hazard Mitigation Planning Committee, Stakeholders and Consultant Team

1. Introductions
2. Review of the Planning Process and Progress to Date
3. Update Mitigation Goals & Objectives
4. Review of progress on Mitigation Actions from 2017 Plan
5. Review of Mitigation Action Categories
6. Development of New Mitigation Actions
7. Next steps
8. Questions and Answers

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Thornton-Federal Heights-Northglenn, Colorado
2021-2022 Multi-Jurisdictional Hazard Mitigation Plan Update

Mitigation Strategy Meeting Summary

March 3, 2022, 9:00 – 11:00 am

Introductions

Scott Field, Project Manager, Wood Environment and Infrastructure Solutions (Wood) kicked off the virtual meeting and thanked everyone for their participation. Scott introduced the Wood team and asked all attendees to type their name, jurisdiction, and title in the chat for attendance keeping purposes. In total 29 individuals participated in the webinar representing the consultant team and the Cities of Thornton, Federal Heights, and Northglenn, as well as special districts, stakeholders, and partner organizations.

Review of the Planning Process

The FEMA planning process steps were recapped; Wood is currently wrapping up the Risk Assessment process and beginning the mitigation strategy portion. This virtual meeting addressed mitigation strategizing and revisions/refinements to the goals of the participating jurisdictions.

The roles of the participating jurisdictions in the HMPC vs. Stakeholders were reviewed, as differentiated under FEMA's eyes. Only the participating jurisdictions, will be specifically addressed in the plan and will be required to meet certain criteria such as attending planning meetings, identifying mitigation actions, and tracking other aspects in order to qualify for funding in the future. While other entities (i.e. everyone else) were key stakeholders that would provide useful input and feedback as well as review the Hazard Mitigation Plan (HMP) drafts.

The progress on the plan update process to date was reviewed. Highlights include:

- Kickoff meeting held October 21st
- Risk Assessment meeting held December 8th
- Online Public Survey conducted
- HIRA Draft out for HMPC review week of March 7th

Public Survey Results

In total 147 responses were received in the public survey. Of the respondents 56 live in Thornton, 60 in Northglenn, and 23 in Federal Heights, with 8 respondents marking "other". 87 persons noted living in community for over 10 years. The survey also asked, "How many times has a natural hazard disrupted your daily life in the last five years?" Most individuals noted their daily life being disrupted 1-2 times in the past five years.

The top five hazards of concern based on this public survey were:

- Drought
- Severe Storms

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- Winter Storm
- Cyber Attack
- Extreme Temperatures

The final question reviewed was asking the public to indicate the types of mitigation actions that they think should have the highest priority in the plan update. The top five actions indicated by the public were:

- Water Conservation
- Generators for critical facilities
- Improved reliability of communication systems
- Public health incident preparedness
- Expanded indoor/outdoor warning systems

Handouts showing the entire survey results were emailed to the meeting attendees. The HMPC and stakeholders were encouraged to review the survey results and take them into account when developing mitigation goals, objectives, and actions.

2022 Hazard Summary

The Hazard Summary table was briefly reviewed. The group then reviewed the risk summary rankings by jurisdictions. The HMPC will also have an additional opportunity to review the overall significance of each hazard and provide comments while reviewing the draft HIRA.

Mitigation Goals and Objectives

The goals from the 2017 Hazard Mitigation Plan were revisited. Key differences between "goals," "objectives" and "actions" were defined: goals and objectives are usually more general and broad guidelines while actions are specific and project driven. Projects submitted for grant funding will need to tie back to goals and objectives in the HMP. The revised 2022 Thornton-Federal Heights-Northglenn Hazard Mitigation Plan goals for each of the three cities are as follows.

Thornton:

- Goal 1: Protect and enhance the resiliency of people, property, critical systems, and natural resources.
- Goal 2: Improve Thornton's ability to prevent and reduce physical, economic, and societal losses from disasters
- Goal 3: Enhance Thornton's ability to recover quickly and completely from future disaster incidents
- Goal 4: Ensure that functionality of local critical facilities and systems are maintained in the event of a disaster
- Goal 5: Strengthen communication and coordination among public agencies, NGOs, businesses, and residents to better prepare for, respond to, and recover from disaster situations
- Goal 6: Increase public awareness of hazard risks, vulnerabilities, and mitigation measures & resources
- Goal 7: Integrate hazard mitigation into planning documents, budgeting processes, and other mechanisms

Federal Heights:

- Goal 1: Improve capability to reduce disaster losses

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- Goal 2: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 3: Increase public awareness of natural hazards and mitigation options
- Goal 4: Integrate hazard mitigation into other planning mechanisms
- Goal 5: Increase the city's resilience to hazards during all phases of the Emergency Management Cycle
- Goal 6: Increase individual resilience to hazards

Northglenn:

- Goal 1: Protect people, property, and natural resources
- Goal 2: Improve capability to reduce disaster losses
- Goal 3: Strengthen communication and coordination among public agencies, NGOs, businesses, and citizens
- Goal 4: Increase public awareness of natural hazards and mitigation options

Review of Progress on Existing Mitigation Actions

Prior to the webinar, a Mitigation Action Tracker was sent to the HMPC listing each jurisdiction's 2017 mitigation actions. Each HMPC representative was asked to provide status to provide comments on the status of each action. The Tracker was emailed again following the webinar to fill in some of the missing statuses. The mitigation action statuses are categorized as one of the following: Completed, Annual Implementation, In Progress, Not Started and Deleted.

Some examples of "Deleted" actions may be due to lack of project applicability over time, or even inability to complete a project in an area where the community does not have control/jurisdiction (e.g. state owned vs. federal land).

Annual Implementation are actions that a jurisdiction is conducting on an ongoing basis, but which the jurisdiction wants to continue forward into the updated plan to maintain visibility on the action.

Mitigation Actions

Amy Carr led a discussion on what FEMA considers to be mitigation, with several examples on specific categories of actions that the jurisdictions could pursue. One way to think of mitigation actions is the four A's:

- Altering a hazard,
- Averting a hazard,
- Avoiding a hazard,
- Adapting to a hazard

FEMA suggests these four categories for mitigation actions:

- Plans and Regulations,
- Structure and Infrastructure Projects,
- Education and Awareness, and
- Natural Systems Protection.

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Resources for more details on mitigation action types, categories, and example projects were provided, including a short discussion on climate change and adaptation considerations. Example hazard-specific mitigation projects were discussed including FEMA funding-eligible projects for drought/extreme heat, winter storm, flooding, and other hazards

While discussing actions there were comments on the feasibility of some actions, for example planting trees to combat extreme heat which could introduce new issues such as maintenance costs and increased water usage. Scott discussed with the HMPC the importance of the prioritization process, where they could refine which kinds of actions that would be best suited to this community and the priority in which they should be pursued. Scott also noted that FEMA will not be looking to approve or deny the plan based on whether or not actions are completed, but rather be looking for a comprehensive range of actions that are suited to the community and it's hazards.

Developing New Mitigation Actions

Each participating jurisdiction is required to develop at least one new action for the 2022 plan update. Ideally, jurisdictions should develop actions that address all the hazards addressed in the plan, or at least the High significance hazards, but FEMA Region VIII does not require this. All jurisdictions that participate in the National Flood Insurance Program (NFIP) will need to have a mitigation action addressing continued NFIP compliance.

The following are resources with ideas and examples of mitigation actions and implementation:

- FEMA's Mitigation Idea: https://www.fema.gov/media-library/assets/documents/30627
- Colorado Planning for Hazards Guide: https://planningforhazards.com/home

A link to the New Mitigation Action Survey was shared during the meeting and emailed after. Each HMPC member was asked to fill out the survey with at least one mitigation action by March 20th.

New Mitigation Actions Survey: https://forms.office.com/r/guQL1E1m6c

Next Steps

The next steps in the HMP update process were briefly discussed and the project milestones and prospective timeline for task completions were presented. The Wood team mentioned that the next HMPC meeting will include prioritizing new mitigation actions and reviewing the draft plan. The specific day and time would be set soon.

Project Milestone	Anticipated Timeline
• Updated HIRA for Review	March
• HMPC Review Draft	Late March
• Public Review Draft	April
• CO DHSEM Review	Late April
• FEMA Review (estimated)	May – June

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- Final Approved HMP for local adoption July

Questions and Answers/Adjourn

The webinar adjourned around 11:00 am.

Points of Contact for this HMP update effort:

Scott Field
Wood E&IS Project Manager
scott.field@woodplc.com
303-742-5320

Martin Postma
City of Thornton
Martin.Postma@thorntonco.gov

Marc Mahoney
City of Federal Heights
mmahoney@fedheights.org

Becky Smith
City of Northglenn
bsmith@northglenn.org

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Meeting Chat Log:

[8:58 AM]
Josh Redman has temporarily joined the chat.

[8:59 AM]
Michelle King has temporarily joined the chat.

[8:59 AM]
Michelle King has temporarily joined the chat.

[8:59 AM]
Sean Saddler has temporarily joined the chat.

[8:59 AM]
Tom Green has temporarily joined the chat.

[9:00 AM]
Craig Towler (CPWD) (Guest) has temporarily joined the chat.

[9:00 AM]
Jim Kaiser has temporarily joined the chat.

[9:00 AM]
sgarrington has temporarily joined the chat.

[9:01 AM]
Colin Haggerty has temporarily joined the chat.

[9:01 AM]
Annemarie Fortune, TCHD (she/her) (Guest) has temporarily joined the chat.

[9:02 AM]
Osvirk, Mark has temporarily joined the chat.

[9:02 AM]
Osvirk, Mark has temporarily joined the chat.

[9:04 AM]
Angelica Wineland has temporarily joined the chat.

[9:05 AM]
Emily Hunt has temporarily joined the chat.

[9:05 AM] Angelica Wineland
Angie Wineland, Emergency Preparedness Manager, Adams 12 Five Star Schools

[9:06 AM] Colin Haggerty

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Colin Haggerty, Watershed Manager, Mile High Flood District

[9:06 AM] Emily Hunt
Emily Hunt, City of Thornton - Water Utility

[9:06 AM] Annemarie Fortune, TCHD (she/her) (Guest)
Annemarie Fortune, Land Use and Built Environment Specialist, Tri-County Health Department

[9:06 AM] sgarrington (Guest)
Sara Garrington, TCHD

[9:06 AM] sgarrington (Guest)
Sara Garrington, TCHD

[9:06 AM] Jason Hollands
Jason Hollands, Thornton Fire Department

[9:06 AM] Sean Saddler
Sean Saddler, Contracts and Purchasing Director, City of Thornton

[9:06 AM] Josh Redman
Josh Redman, Utilities Operations Manager, City of Thornton

[9:06 AM] Stephen Kelley
Steve Kelley, Thornton Fire Department

[9:06 AM] Jim Kaiser
Jim Kaiser, Thornton Floodplain Administrator

[9:06 AM] Mitch Pullam
Mitch Pullam, Manger Environmental Compliance - RTD

[9:07 AM] Craig Towler (CPWD) (Guest)
Craig Towler, Community Organizer, Center for People With Disabilities
Email: craig@cpwd.org

[9:07 AM] William Farr
William Farr Division Commander Thornton Police Department

[9:07 AM] Martin Postma
Martin Postma, City of Thornton, Long Range Planning

[9:07 AM] Michelle King
Michelle King, KADEP Senior Director (King Adult Day Enrichment Program at the Rocky Mountain MS Center) we are in Westminster but serve residents in all 3 cities.

[9:07 AM] Carr, Amy

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Amy Carr, Hazard Mitigation Planner, Wood

[9:08 AM] Osvirk, Mark
Mark Osvirk, Director of Safety, Community Reach Center, Thornton

[9:08 AM] Marc Mahoney
Marc Mahoney City of Federal Heights Fire Chief and Emergency Manager

[9:09 AM]
Nathan Marx has temporarily joined the chat.

[9:10 AM]
Perry Edman has temporarily joined the chat.

[9:10 AM]
Tara Galanski has temporarily joined the chat.

[9:12 AM] Johnson, Christopher A
Christopher Johnson, Hazard Mitigation Planner, Wood

[9:13 AM] Nathan Marx
Nathan Marx, Transit Safety Specialist, RTD

[9:13 AM] Tara Galanski
Tara Galanski, RTD, Environmental Specialist

[9:14 AM]
Rachel Pierstorff has temporarily joined the chat.

[9:14 AM]
Becky Smith (Guest) has temporarily joined the chat.

[9:14 AM] Ryan Doyle
Ryan Doyle, Thornton Fire OEM

[9:19 AM] Annemarie Fortune, TCHD (she/her) (Guest)
Makes sense, thanks for the background!
like 1

[9:24 AM] Carr, Amy
If you've just joined or haven't done so already, please add your Name, Title, and Organization to the chat log. This will serve as our sign in sheet for this meeting. Thank you!

[9:29 AM]
Emily Palmer, DHSEM (Guest) has temporarily joined the chat.

[9:30 AM]
Craig Towler (CPWD) (Guest) no longer has access to the chat.

wood.

[9:34 AM] Becky Smith (Guest)
I think that given NGs focus on equity we would likely be interested in adding something to that effect.
Thanks for sharing that idea Annemarie!

[9:48 AM] Johnson, Christopher A
https://treeequityscore.org/map/#11.2/39.9722/-75.0767
Tree Equity Score
Find your score and help create Tree Equity in cities and towns across America.

[9:58 AM]
Tami Moon has temporarily joined the chat.

[10:01 AM]
Jessica Romito has temporarily joined the chat.

[10:15 AM] Carr, Amy
https://www.fema.gov/sites/default/files/2020-08/fema_mitigation-action-portfolio-support-document_08-01-2020_0.pdf

[10:19 AM] Carr, Amy
https://planningforhazards.com/home
Home | Planning For Hazards

[10:22 AM] Annemarie Fortune, TCHD (she/her) (Guest)
yep!

[10:25 AM] Carr, Amy
https://forms.office.com/r/guQL1E1m6c
Fill | Thornton, Federal Heights, Northglenn Hazard Mitigation Plan - New Mitigation Action

[10:33 AM] Jim Kaiser
Can we still complete the linked form which Wood can then send to Martin for our review team

[10:34 AM] Tom Green
United Power does our own annual mitigation projects independently (and on our dime) so would we still need to submit a form?

[10:36 AM] Tom Green
i did submit a summary to martin

[10:49 AM] Emily Hunt
Thank you, I need to sign off.
like 1

[10:52 AM]
Annemarie Fortune, TCHD (she/her) (Guest) no longer has access to the chat.

wood.

[10:53 AM]
Emily Palmer, DHSEM (Guest) no longer has access to the chat.

[10:55 AM] Nelson, Cameron
Thanks! So glad to be here!!!

[10:55 AM] Angelica Wineland
Thanks for including us!

[10:55 AM]
Osvirk, Mark no longer has access to the chat.

[10:56 AM] Jessica Romito
Jessie Romito - City of Thornton

[10:56 AM] Mitch Pullam
Thanks!

[10:56 AM]
Tom Green no longer has access to the chat.

[10:56 AM]
Rachel Pierstorff no longer has access to the chat.

[10:56 AM]
sgarrington no longer has access to the chat.

[10:56 AM]
Becky Smith (Guest) and Colin Haggerty no longer have access to the chat.

[10:56 AM]
Angelica Wineland no longer has access to the chat.

[10:57 AM]
Michelle King no longer has access to the chat.

[10:57 AM]
10:57 AM Meeting ended: 2h 27m 30sMeetingTranscript

Selection and Prioritization Criteria and Example Mitigation Action Items

Mitigation Action Selection and Prioritization Criteria

- Does the proposed action protect lives or vulnerable populations?
- 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)?
- Is there a strong advocate for the action or project that will support the action's implementation?

STAPLE/E

Developed by FEMA, this method of applying evaluation criteria enables the planning team to consider in a systematic way the social, technical, administrative, political, legal, economic, and environmental opportunities and constraints of implementing a particular mitigation action. For each action, the HMPC should ask, and consider the answers to, the following questions:

Social - Does the measure treat people fairly (different groups, different generations)? Does it consider social equity, disadvantaged communities, or vulnerable populations?

Technical - Will it work? (Does it solve the problem? Is it feasible?)

Administrative - Is there 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 it?

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? Does it reduce direct property losses or indirect economic losses?

Environmental - Does it comply with environmental regulations or have adverse environmental impacts?

Example Mitigation Action Items

Alternative Mitigation Actions	Dam Failure	Floods	Hazardous Materials	Drought	Weather Extremes (hail, lightning, temps.)	Wind/ Tornado	Wildland Fires	Severe Winter Storm
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		■			■	■		
Minimize hazardous materials waste generation			■					
Multi-Jurisdiction Cooperation within watershed	■	■		■				
Open space preservation	■	■					■	
Performance standards	■	■		■	■	■	■	■
Periodically contain/remove wastes for disposal			■					
Pesticide/herbicide management regulations			■					
Special use permits	■	■	■				■	
Stormwater management regulations		■	■					
Subdivision and development regulations	■	■	■	■		■	■	
Surge protectors and lightning protection					■			
Tree Management				■	■	■	■	■
Transfer of development rights		■					■	
Utility location			■		■	■		■

1

PROPERTY PROTECTION								
Acquisition of hazard prone structures	■	■					■	
Facility inspections/reporting	■	■	■					
Construction of barriers around structures	■	■	■					
Elevation of structures	■	■						
Relocation out of hazard areas	■	■	■				■	
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				■	■			
Lightning detectors in public areas					■			
NATURAL RESOURCE PROTECTION								
Best Management Practices (BMPs)		■	■	■	■		■	
Forest and vegetation management	■	■		■	■		■	■
Hydrological Monitoring	■	■	■	■	■			
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	■	■	■		■	■	■	■
Facility employee safety training programs	■	■	■		■	■	■	■
Hazard threat recognition	■	■	■	■	■	■	■	■
Hazard warning systems (community sirens, NOAA weather radio)	■	■	■		■	■	■	■
Health and safety maintenance	■	■	■	■	■	■	■	■
Post-disaster mitigation	■	■	■	■	■	■	■	■
Evacuation planning	■	■	■				■	

STRUCTURAL PROJECTS								
Channel maintenance		■						
Dams/reservoirs (including maintenance)	■	■						
Isolate hazardous materials waste storage sties			■					
Levees and floodwalls (including maintenance)		■						
Safe room/shelter					■	■		■
Secondary containment system			■					
Site reclamation/restoration/revegetation		■	■	■				
Snow fences								■
Water supply augmentation				■	■			

3

Public Input Survey

Public Survey Outreach



City of Northglenn Government
Dec 30

What's the plan if there's a zombie apocalypse? Okay, that one might be outside our scope, but we do have a Hazard Mitigation Plan to address known risks to residents – tornado, cyber-attacks, prolonged and devastating heat and drought, and more. We need residents to weigh in and help us make updates to this plan. Take the survey here: www.tfhnmitigation.com.



Like Comment Share



See Appendix D for Public Survey responses.

Public Comment Period

Public Comment Period Outreach



From: Becky Smith <bsmith@northglenn.org>
Sent: Wednesday, August 3, 2022 7:39 AM
To: Field, Scott
Subject: FW: Hazard Mitigation Plan Public Review Draft

Follow Up Flag: Flag for follow up
Flag Status: Flagged

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Fyi

Becky Smith, AICP
Planning Manager
(she, her, hers) ***What's This?***
P: 303-450-8741 | M: 303-803-6493
bsmith@northglenn.org
11701 Community Center Drive | Northglenn, CO 80233
www.northglenn.org

From: Diana Wilson <dwilson@northglenn.org>
Sent: Tuesday, August 2, 2022 4:35 PM
To: Becky Smith <bsmith@northglenn.org>
Cc: John Eisel <jeisel@northglenn.org>
Subject: RE: Hazard Mitigation Plan Public Review Draft

Hi Becky,

Here is the web story I threw up real quick (linked on city website main page, too):
https://northglenn.org/news_detail_T17_R537.php

And here are the social posts – same posts twice on Facebook and Twitter (this week and next), tomorrow and 8/10.

Facebook:

Desktop



Twitter:

Mobile



And I did a web story:

!
!
%D<I<!

From: Becky Smith <bsmith@northglenn.org>
Sent: Monday, August 1, 2022 10:18 AM
To: Diana Wilson <dwilson@northglenn.org>; John Eisel <jeisel@northglenn.org>
Subject: FW: Hazard Mitigation Plan Public Review Draft

Please save screenshots of the HMP posts. Thanks!

Becky Smith, AICP
Planning Manager
(she, her, hers) ***What's This?***
P: 303-450-8741 | M: 303-803-6493
bsmith@northglenn.org
11701 Community Center Drive | Northglenn, CO 80233
www.northglenn.org

From: Field, Scott <scott.field@woodplc.com>
Sent: Friday, July 29, 2022 3:56 PM
To: Martin Postma <Martin.Postma@thorntonco.gov>; Becky Smith <bsmith@northglenn.org>; Marc Mahoney <mmahoney@fedheights.org>
Cc: Ryan Doyle <Ryan.Doyle@thorntonco.gov>; Rachelle Plas <Rachelle.Plas@thorntonco.gov>
Subject: RE: Hazard Mitigation Plan Public Review Draft

Oh I forgot to add: please send me screenshots of your posts/tweets/whatever for documentation. Thanks.

W. Scott Field, CEM
Senior Emergency Management Specialist
He/him/his
Phone: 720-569-9266
scott.field@woodplc.com
www.woodplc.com

wood.

From: Martin Postma <Martin.Postma@thorntonco.gov>
Sent: Friday, July 29, 2022 3:41 PM
To: Field, Scott <scott.field@woodplc.com>; Becky Smith <bsmith@northglenn.org>; Marc Mahoney <mmahoney@fedheights.org>
Cc: Ryan Doyle <Ryan.Doyle@thorntonco.gov>; Rachelle Plas <Rachelle.Plas@thorntonco.gov>
Subject: RE: Hazard Mitigation Plan Public Review Draft

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Thank you, Scott.

I will take care of sending this out to the people we have invited to our community meetings.

Please actively promote this among residents, businesses, staff members, organizations, etc.

Thanks and have a good weekend.

Martin

From: Field, Scott <scott.field@woodplc.com>
Sent: Friday, July 29, 2022 2:47 PM
To: Martin Postma <Martin.Postma@thorntonco.gov>; Becky Smith <bsmith@northglenn.org>; Marc Mahoney <mmahoney@fedheights.org>
Cc: Ryan Doyle <Ryan.Doyle@thorntonco.gov>; Rachelle Plas <Rachelle.Plas@thorntonco.gov>
Subject: (External) Hazard Mitigation Plan Public Review Draft

The public draft of the 2022 Thornton, Federal Heights, & Northglenn Hazard Mitigation Plan is ready for public review!

We have created a Virtual Room for the public to learn about, download, and comment on the plan. Please give it a look and let me know what you think or if you find any glitches: https://virtual.woodplc.com/VirtualSpace/115631

We're also updating the www.tfhnmitigation.com website so it points to the virtual room & comment form.

The draft base plan and annexes can be downloaded through the virtual room, or you can also download them through the same Google Drive folder we've used before:
https://drive.google.com/drive/folders/1_Q30fGdlCvokymHSACAnovBgJhCe7mRN?usp=sharing

4

Please help advertise the public draft and ask your partner agencies to do the same. Sample language follows, but feel free to edit as you see fit. We put August 14th as the date the comment period ends, but there's nothing magic about the date if you'd rather keep it open longer or whatever.

You may also want to post the plan documents on your website in case people have trouble with the virtual room. If you do so, the direct link to the comment form is: https://forms.office.com/r/UPnD5nmzgg

Sample language to advertise the public comment period:

> The Cities of Thornton, Federal Heights, & Northglenn are updating our joint Hazard Mitigation Plan. This plan analyzes the City's vulnerabilities to natural and human-caused hazards, and identifies mitigation actions we can take to lessen the impacts of disasters minimizing property damage and reducing the loss of life.
>
> The Thornton, Federal Heights, & Northglenn Hazard Mitigation Plan is updated every five years as required by the Federal Disaster Mitigation Act of 2000. This update ensures the jurisdictions remain eligible for federal pre- and post-disaster financial assistance.
>
> The draft 2022 Hazard Mitigation Plan is being made available for public review and comment before it is finalized. https://virtual.woodplc.com/VirtualSpace/115631
>
> Please provide comments by August 14th, 2022. Thank you for your input!

W. Scott Field, CEM
Senior Emergency Management Specialist
He/him/his
Phone: 720-569-9266
scott.field@woodplc.com
www.woodplc.com

wood.


City of Thornton, Colorado Government
Published by Hootsuite · August 3 at 4:01 PM ·
The cities of #Thornton, Federal Heights City Government & City of Northglenn Government are updating our joint Hazard Mitigation Plan and it is available for public review and comment before it is finalized. Visit www.tfhnmitigation.com by August 14 to view the draft plan and provide comments.
REVIEW THE DRAFT OF THE 2022 HAZARD MITIGATION PLAN
The city of Thornton, in partnership with the cities of Federal Heights and Northglenn, is near the end of the process of updating the Hazard Mitigation Plan.
The draft 2022 Hazard Mitigation Plan is now available for public review and comment before it is finalized.
The plan covers:
Natural Hazards
strong winds
extreme temperatures
public health concerns
earthquakes
flooding
hail
drought
Human-Made Hazards
cybersecurity attacks
mass-transportation incidents
hazardous material spills
To view the draft plan and provide comments, visit: TFHNMITIGATION.COM

From: Martin Postma <Martin.Postma@thorntonco.gov>
Sent: Tuesday, August 2, 2022 7:45 AM
To: Martin Postma
Subject: Hazard Mitigation Plan - Thornton Federal Heights Northglenn - Public Review

Follow Up Flag: Flag for follow up
Flag Status: Flagged

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Greetings,

The Cities of Thornton, Federal Heights, & Northglenn are updating our joint Hazard Mitigation Plan. This plan analyzes the City's vulnerabilities to natural and human-caused hazards, and identifies mitigation actions we can take to lessen the impacts of disasters minimizing property damage and reducing the loss of life.

The Thornton, Federal Heights, & Northglenn Hazard Mitigation Plan is updated every five years as required by the Federal Disaster Mitigation Act of 2000. This update ensures the jurisdictions remain eligible for federal pre- and post-disaster financial assistance.

The draft 2022 Hazard Mitigation Plan is being made available for public review and comment before it is finalized. https://virtual.woodplc.com/VirtualSpace/115631 The Plan can also be reviewed here: www.tfhnmitigation.com

Please provide comments by August 14th, 2022. Thank you for your input!

Martin Postma
Senior Policy Analyst
City of Thornton
303 538 7631
martin.postma@thorntonco.gov

1

See Appendix D for public comments submitted.

APPENDIX D: PUBLIC INPUT

As part of the planning and public engagement process of the Cities of Thornton, Federal Heights, and Northglenn Hazard Mitigation Plan, a 9-question web-based survey was created and distributed via numerous channels. The purpose of the survey was to collect information from the public and stakeholders to better understand the public perception of hazards in Broomfield.

The online survey opened on December 29th, 2021, and closed on March 9th, 2022. The link to the survey was distributed to members of the Hazard Mitigation Planning Team, who were encouraged to broadcast the link far and wide through their constituent network. The survey was also advertised to Thornton, Federal Heights, and Northglenn social media networks. A total of 155 responses were received. The following graphics summarize the data collected from this effort.

1. Please indicate the community where you live

More Details

City of Thornton	58
City of Northglenn	65
City of Federal Heights	24
Other	8



2. How long have you lived in this community?

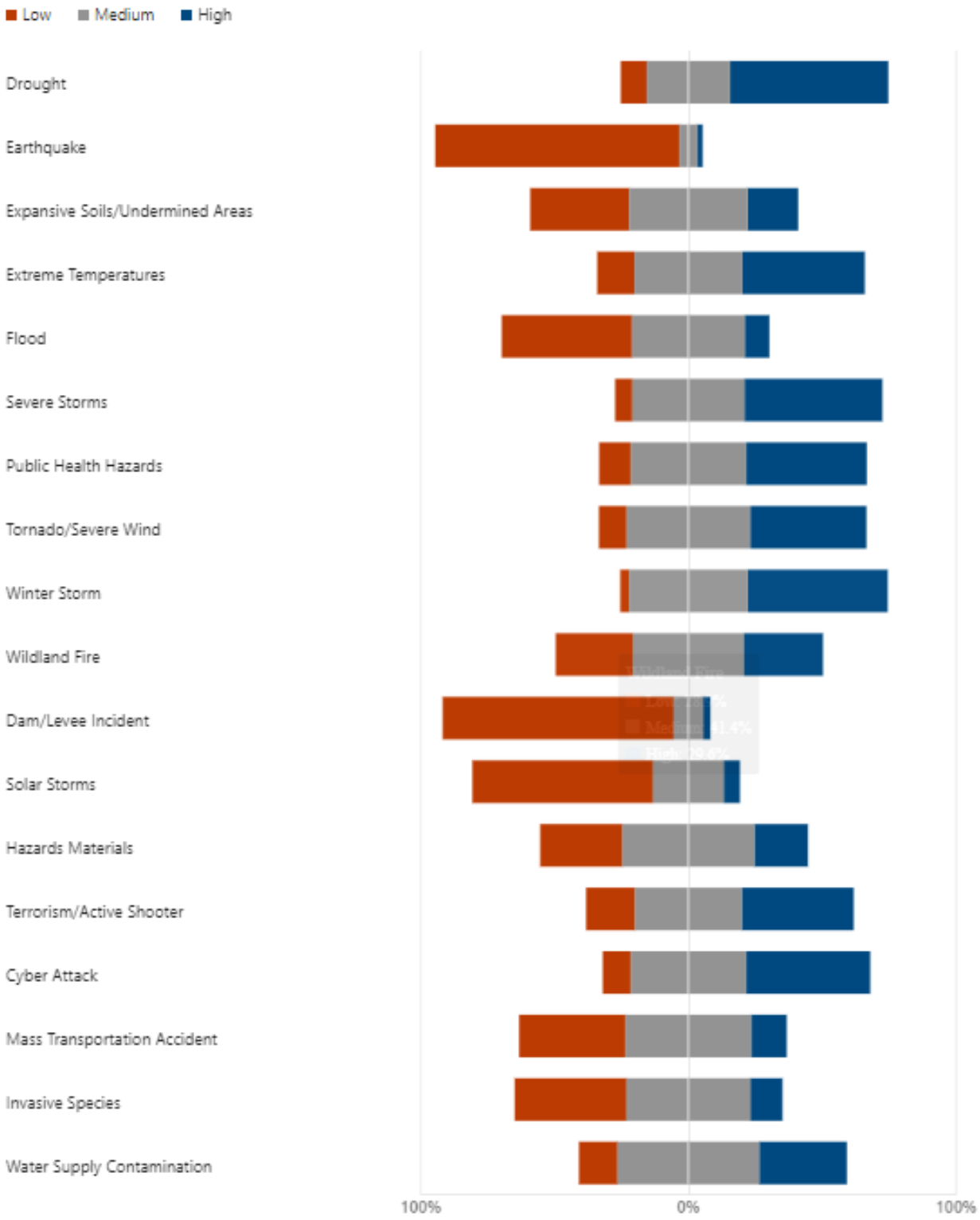
More Details

Less than 1 year	11
1-5 years	26
5-10 years	26
Over 10 years	92



3. The hazards addressed in the Hazard Mitigation Plan update are listed below. Please indicate the level of significance that you perceive for each hazard in your city.

More Details



5. How many times has a natural hazard disrupted your daily life in the last five years?

More Details

0	39
1-2	68
3-5	31
More than 5 times	17



6. Do you have information on specific hazard issues/problem areas that you would like the planning committee to consider? Note the jurisdiction to which it applies:

More Details Insights

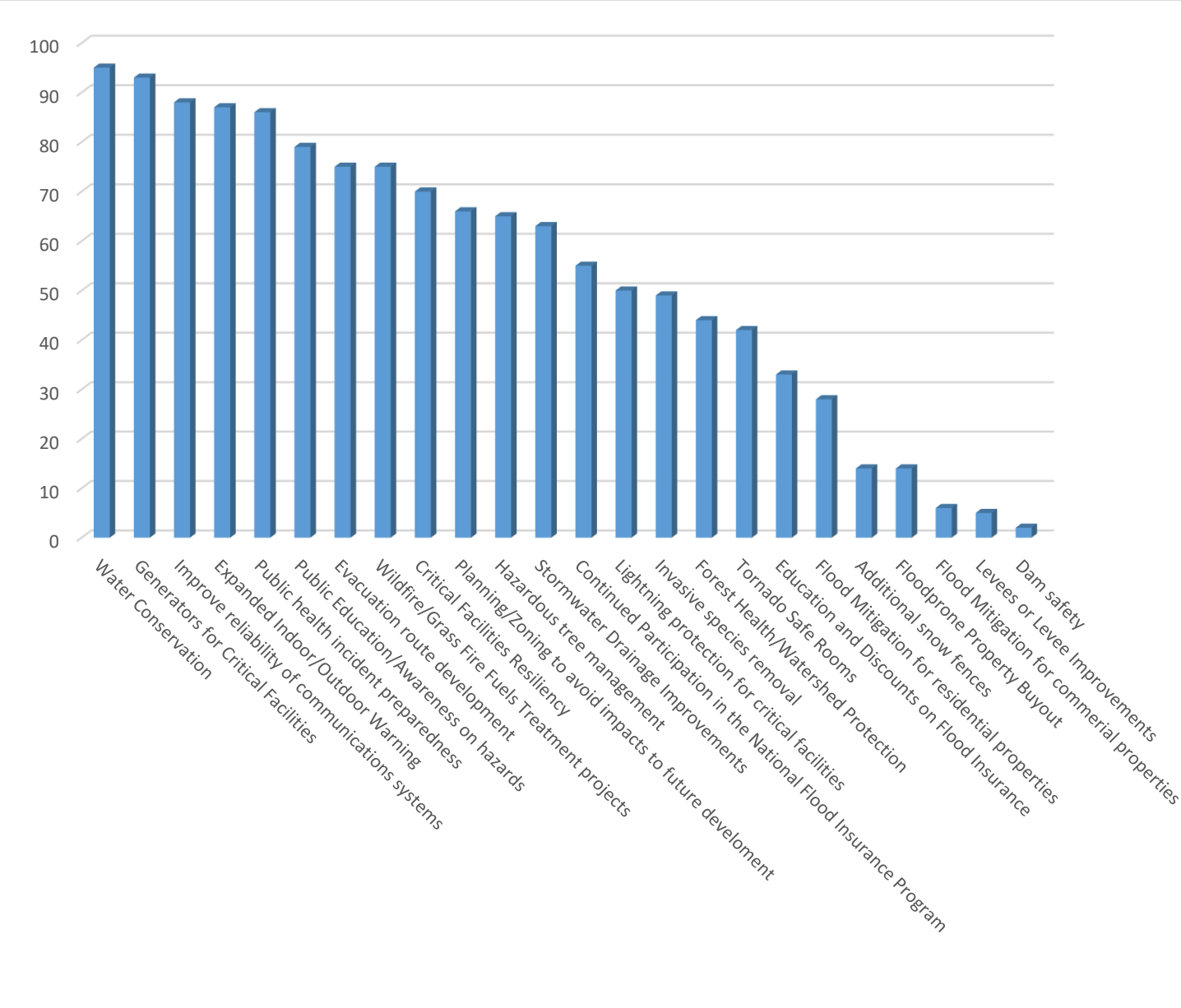
53
Responses

Latest Responses
"No not yet"

9 respondents (**17**%) answered **fire** for this question.



7. The following types of mitigation activities may be considered in the planning area. Please indicate the types of mitigation actions that you think should have the highest priority in the Thornton-Federal Heights-Northglenn Hazard Mitigation Plan.



8. Please comment on any other pre-disaster strategies that the planning committee should consider for reducing future losses caused by natural disasters:

More Details Insights

34
Responses

Latest Responses
"N/A"

6 respondents (**18**%) answered **fires** for this question.



The public was also given an opportunity to review and comment on the draft plan August 1-14, 2022. One public/stakeholder comment was submitted, which is shown below.

From: Dan Hill <dhill@mhfd.org>
Sent: Thursday, August 11, 2022 1:46 PM
To: Martin Postma <Martin.Postma@thorntonco.gov>
Cc: Andy Stewart <astewart@mhfd.org>; Colin Haggerty <chaggerty@mhfd.org>; Jim Kaiser <Jim.Kaiser@thorntonco.gov>; Rachelle Plas <Rachelle.Plas@thorntonco.gov>
Subject: (External) RE: Hazard Mitigation Plan - Thornton Federal Heights Northglenn - Public Review

Hi Martin,

Providing you comments here via email – would you like these comments in any other format(s)?

Thank you for including discussion of MHFD floodplain studies that are more recent than FEMA mapping in section 4.8 – Flood.

Please note that the resolution of Figure 4-13 (FEMA Floodplains) is not as high as Figure 4-14 (MHFD Floodplains).

It would be appropriate to mention the existence of MHFD's Major Drainageway Plans (MDPs) and Outfall System Plans (OSPs) that are long-term planning documents identifying projects to mitigate flooding risks. These are developed in partnership with local governments in the District (Federal Heights, Thornton, and Northglenn included).

I think it would be appropriate to mention these MDPs and OSPs in sections 4.8.3 as our flood mapping studies are mentioned, and/or at the end of section 4.8.7 on page 4-73 in the "Future Land Use and Development" paragraph. Thornton requires future development to adhere to the MDPs and OSPs that they develop in partnership with us at MHFD.

Thanks,
Dan

Dan Hill, P.E., CFM (He, Him, His)
Watershed Manager
MILE HIGH FLOOD DISTRICT
2480 W. 26th Ave Suite 156-B | Denver, Colorado 80211
Office: 303-455-6277 | **Direct:** 303-749-5427 | www.mhfd.org

Protecting People, Property, and our Environment

MILE HIGH FLOOD DISTRICT

APPENDIX E: MITIGATION ALTERNATIVES

As part of the process of developing the mitigation action plans found in Section 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 5 of this plan.

Once it was determined which flood hazards warranted the development of specific mitigation actions, the HMPC analyzed viable mitigation options that supported the identified goals and objectives. The HMPC was provided with the following list of mitigation categories from the 2017 CRS Coordinator's Manual.

1. Prevention
2. Property Protection
3. Natural Resource Protection
4. Structural Projects
5. Emergency Services
6. Public Information and Outreach

E.1 PREVENTATIVE AND REGULATORY MEASURES

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 Figure E-1.

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, greenway corridors and golf courses.

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

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 Cities of Thornton, Federal Heights, and Northglenn has adopted building codes as detailed in Section 3.8.

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.

E.2 PROPERTY PROTECTION MEASURES

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 lakes and larger 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 Section 5 and in greater detail in each community's annex. 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.

E.3 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
- Farmland protection

WETLAND PROTECTION

Wetlands are often found in floodplains and topographically depressed areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and they provide habitat for many species of fish, wildlife, and plants.

EROSION AND SEDIMENTATION CONTROL

Farmlands and 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 river and stream channels, lakes 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 lake 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.

FARMLAND PROTECTION

Farmland protection is an important piece of comprehensive planning and zoning throughout the United States. The purpose of farmland protection is to provide mechanisms for prime, unique, or important agricultural land to remain as such, and to be protected from conversion to nonagricultural uses.

Frequently, farm owners sell their land to residential or commercial developers and the property is converted to non-agricultural land uses. With development comes more buildings, roads, and other infrastructure. Urban sprawl occurs, which can lead to additional stormwater runoff and emergency management difficulties.

Farms on the edge of cities are often appraised based on the price they could be sold for to urban developers. This may drive farmers to sell to developers because their marginal farm operations cannot afford to be taxed as urban land. The Farmland Protection Program in the United States Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to state, tribal, and local governments as well as nonprofit organizations to help purchase easements on agricultural land to protect against the development of the land.

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.

E.4 EMERGENCY SERVICES MEASURES

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.

E.5 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.

Reservoirs can be dry and remain idle until a large rain event occurs. Or they may be designed so that a lake or pond is created. The lake may provide recreational benefits or water supply (which could also help mitigate a drought).

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 lake 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.

E.6 PUBLIC INFORMATION

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.

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APPENDIX G: ACRONYMS AND DEFINITIONS

ACRONYMS

%g	Percentage of gravity
°C	Degrees Celsius
°F	Degrees Fahrenheit
ACS	American Community Survey
BCA	Benefit-Cost Analysis
BCC	Board of County Commissioners
BCEGS	Building Code Effectiveness Grading Schedule
BLM	Bureau of Land Management
BRIC	Building Resilient Infrastructure and Communities
CDC	Centers for Disease Control and Prevention
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health & Environment
CERT	Community Emergency Response Team
CDSB	Colorado Dam Safety Division
CFR	Code of Federal Regulations
CGS	Colorado Geological Survey
CIP	Capital Improvement Plan
CIS	Community Information System
CISA	Cyber & Infrastructure Security Agency
COOP	Continuity of Operations Plan
COVID-19	Coronavirus Disease 2019
CPA	Community Planning Areas
CPG	Comprehensive Preparedness Guide
CRS	Community Rating System
CSFS	Colorado State Forest Service
CWCB	Colorado Water Conservation Board
CWPP	Community Wildfire Protection Plan
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Maps

DHSEM	Division of Homeland Security and Emergency Management
DMA	Disaster Mitigation Act
DMV	Department of Motor Vehicles
DNR	Colorado Department of Natural Resources
DOLA	Colorado Department of Local Affairs
DOT	U.S. Department of Transportation
DR	(Major) Disaster Declaration
DRCOG	Denver Regional Council of Governments
DWR	Colorado Department of Water Resources
EAP	Emergency Action Plan
ECOS	Environmental Conservation Online System
EF	Enhanced Fujita
EM	Emergency Declarations
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flooding Mitigation Assistance
FM	Fire Management Declaration
FPD	Fire Protection District
GIS	Geographic Information System
HAZMAT	Hazardous Materials
Hazus-MH	Hazards, United States-Multi Hazard
HIFLD	Homeland Infrastructure Foundation-Level Data
HHPD	High Hazard Potential Dam
HMA	Hazard Mitigation Assistance

HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPC	Hazard Mitigation Planning Committee
HIRA	Hazard Identification and Risk Assessment
HUD	Housing and Urban Development
HPL	High Potential Loss
IBC	International Building Code
ICC	International Code Council
ISO	Insurance Services Office
LAL	Lightning Activity Level
LEPC	Local Emergency Planning Committee
LHMP	Local Hazard Mitigation Plan
MHFD	Mile High Flood District
MMI	Modified Mercalli Scale
MPH	Miles per Hour
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NFDRS	National Fire Danger Rating System
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NEPA	National Environmental Policy Act
NID	National Inventory of Dams
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NRC	U.S. Coast Guard's National Response Center
NRP	Natural Resource Protection
NWS	National Weather Service
OEM	Office of Emergency Management
OIT	Office of Information Technology (State of Colorado)

ORM	Colorado Office of Risk Management
OSHA	Occupational Safety and Health Administration
PGA	Peak Ground Acceleration
PIF	Pandemic Intervals Framework
PPE	Personal Protective Equipment
RMIIA	Rocky Mountain Insurance Information Association
SBA	Small Business Administration
SCADA	Supervisory Control and Data Acquisition
SCENIC	Southwest Climate and Environmental Information Collaborative
SFHA	Special Flood Hazard Area
SRL	Severe Repetitive Loss Properties
THIRA	Threat and Hazard Identification and Risk Assessment
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFW	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WHO	World Health Organization
WRCC	Western Regional Climate Center
WUI	Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1% annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit/cost analysis of proposed mitigation measures, benefits are limited to specific, measurable risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic or water reactive materials.
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events.
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65%.

Disaster Mitigation Act of 2000 (DMA): The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's FIRM. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A FIRM identifies most, but not necessarily all, of a community's floodplain as the SFHA.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot; the floodway standard in Colorado is 6 inches. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Development may be allowed in this area, but with significant restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1% chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. In 2007, the NWS began rating tornadoes using the **Enhanced Fujita Scale**. The EF-scale is a set of wind estimates (not measurements) based on damage ranked from EF0 to EF5. Standard measurements are taken by weather stations in open exposures.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (Hazus-MH) Loss Estimation Program: Hazus-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. Hazus-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Initiatives (or Mitigation Actions): Mitigation initiatives are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a FIRM. The SFHA is mapped as a Zone A in riverine situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: Wildfire refers to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX H: EXAMPLE ANNUAL PROGRESS MEETING AGENDA AND REPORT

Thornton, Federal Heights, Northglenn Hazard Mitigation Plan
Annual Progress Meeting Agenda

1. **Discussion on hazard events and impacts that occurred during the performance period**
2. **Review of progress on mitigation action implementation**
3. **Discussion on success stories**
4. **Recommendations for new actions/projects**
5. **Review of funding options and grant opportunities**
6. **Review of changes in plan maintenance or implementation**
7. **Review of continuing public involvement**

Thornton, Federal Heights, Northglenn
Hazard Mitigation Plan
Annual Progress Report Template

Reporting Period:

Background: Thornton, Federal Heights, Northglenn developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the Cities, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions-maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed online at:

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2022, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before _____, 2027. The *Thornton, Federal Heights, Northglenn Hazard Mitigation Plan* has targeted 103 hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

__ out of __ initiatives (__%) reported ongoing action toward completion.

__ out of __ initiatives (__%) were reported as being complete.

__ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the *Thornton, Federal Heights, Northglenn Hazard Mitigation Plan*. The objective is to ensure that there is a continuing and responsive planning process that will keep the hazard mitigation plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement

The Hazard Mitigation Planning Committee: The Hazard Mitigation Planning Team, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 202_. It was determined through the plan's development process that the HMPC would remain in service to oversee maintenance of the plan. At a minimum, the HMPC will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the HMPC membership present at the meeting is as indicated in Table 1.

Table 1.		
Name	**Title**	**Jurisdiction/Agency**

Natural Hazard Events within the Planning Area: During the reporting period, there were _____ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

_____

_____

_____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the *Thornton, Federal Heights, Northglenn Hazard Mitigation Plan* for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

Was any element of the initiative carried out during the reporting period?

If no action was completed, why?

Is the timeline for implementation for the initiative still appropriate?

If the initiative was completed, does it need to be changed or removed from the action plan?

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Planning Team, the following recommendations will be noted for future updates or revisions to the plan:

_____

_____

_____

_____

_____

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Thornton, Federal Heights, Northglenn Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here

APPENDIX I: SUPPLEMENTAL MAPS - FOR OFFICIAL USE ONLY

Figure I-1 Critical Facilities

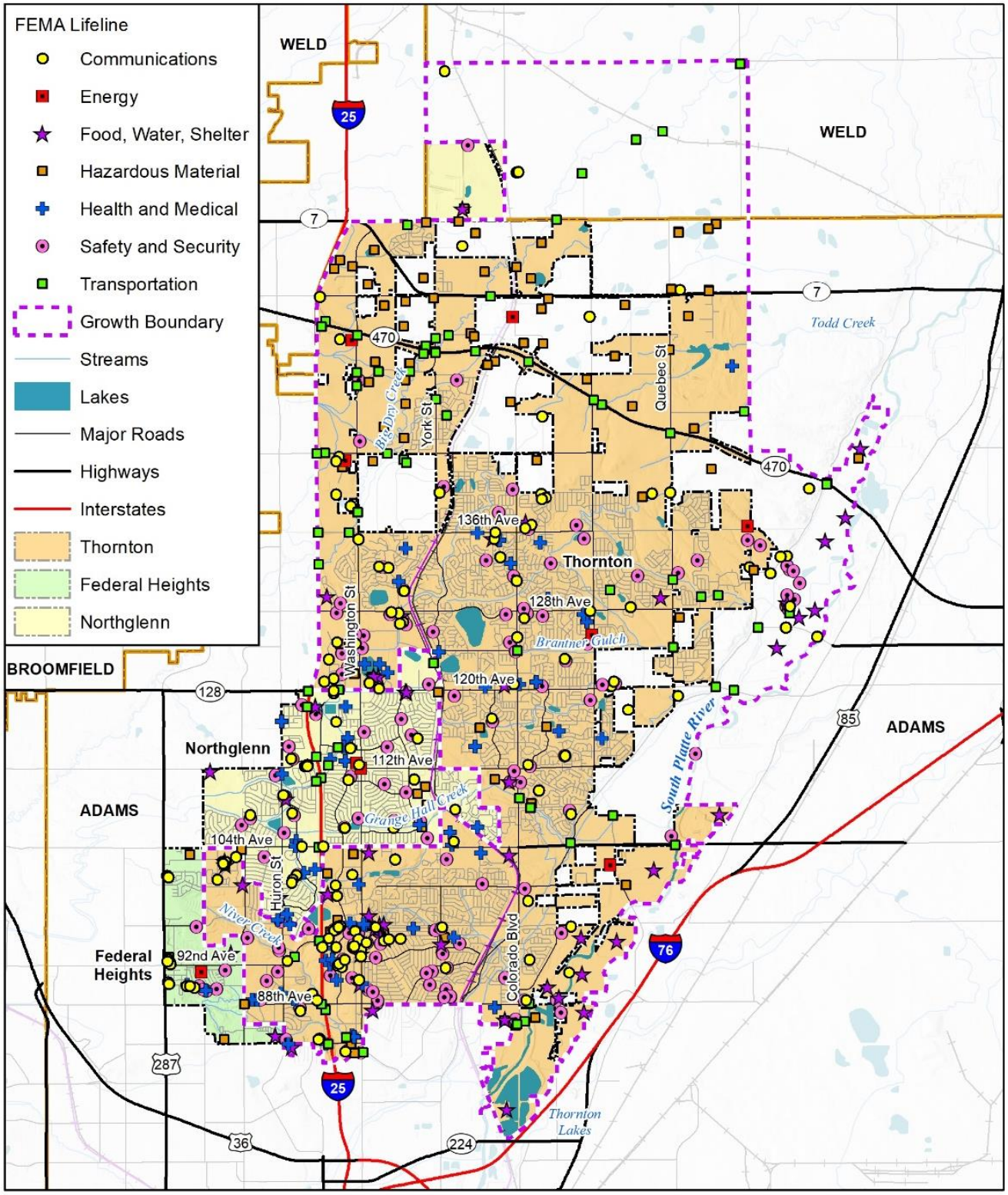
Figure I-2 Dam Inundation Zones in Northglenn

Figure I-3 Dam Inundation Zones in Thornton

Figure I-4 Dam Inundation Zones in the Vicinity of Thornton-Owned Parcels in Larimer and Weld Counties

(Note: There are no mapped dam inundation zones in the City of Federal Heights)

Figure I-1 Critical Facilities



Map compiled 1/2022; intended for planning purposes only.
Data Source: Adams County, Federal Heights, HIFLD, Northglenn, Thornton, CDOT, National Bridge Inventory

0 2.5 5 Miles

N

Figure I-2 Dam Inundation Zones in Northglenn

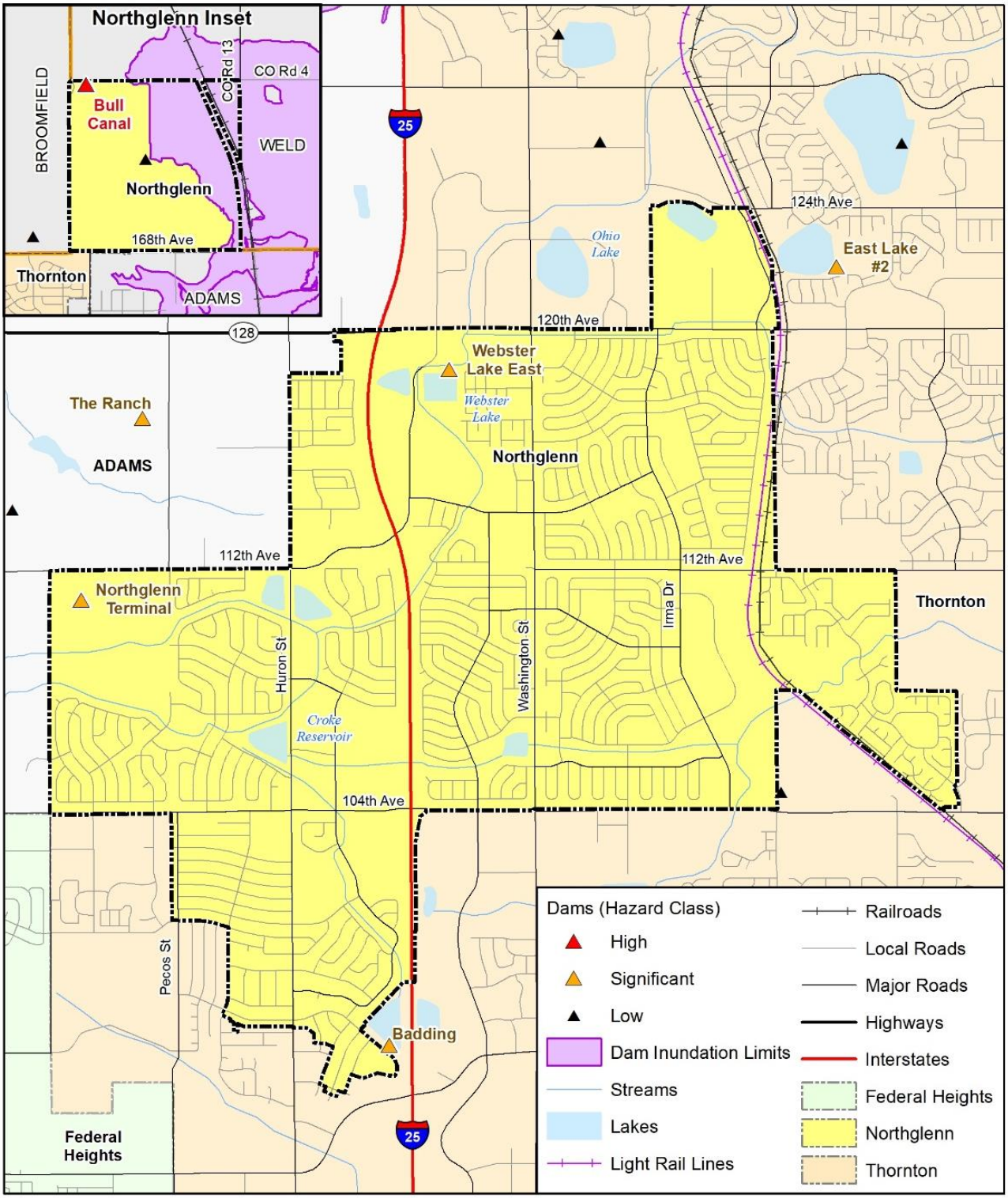


Figure I-3 Dam Inundation Zones in Thornton

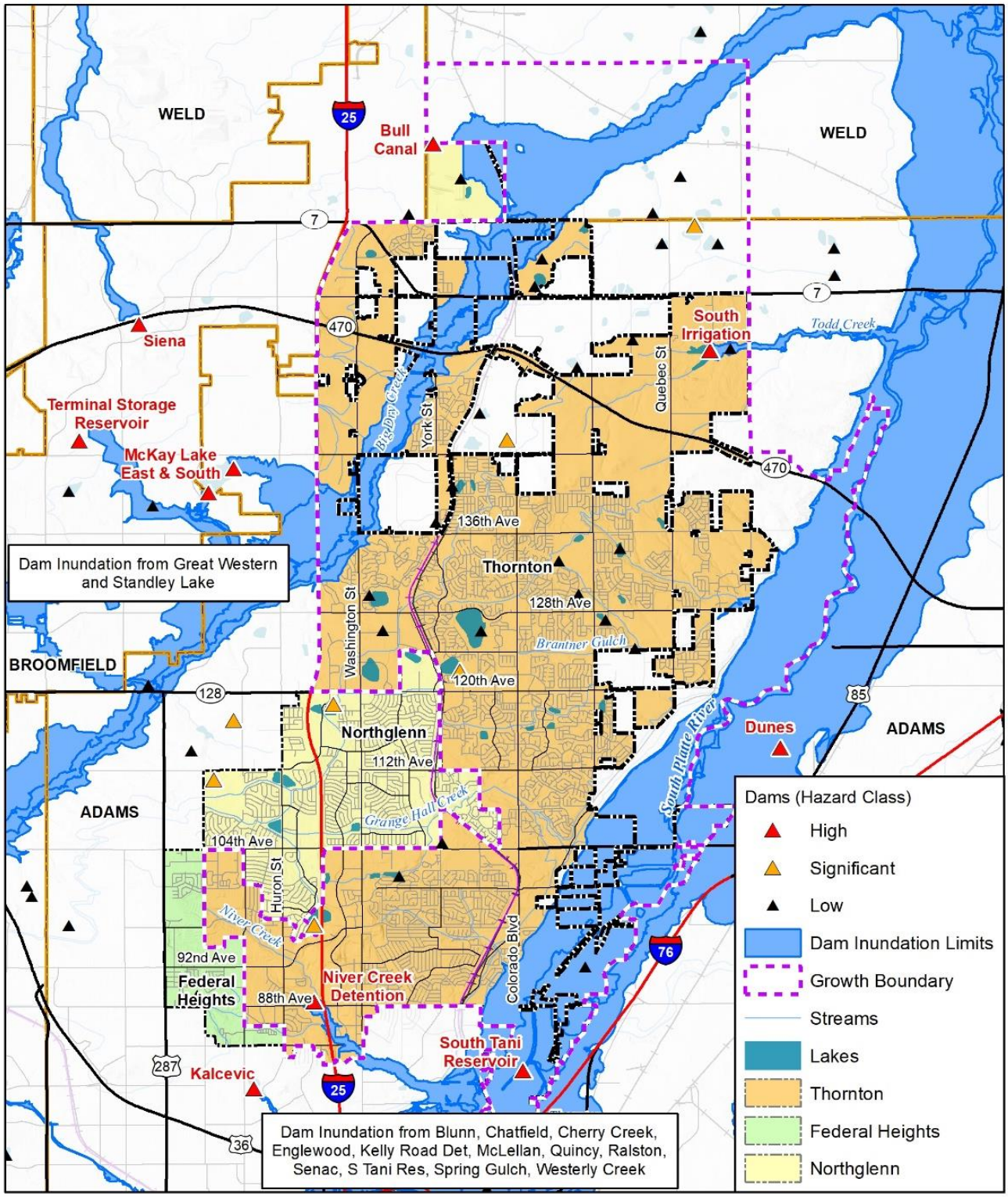
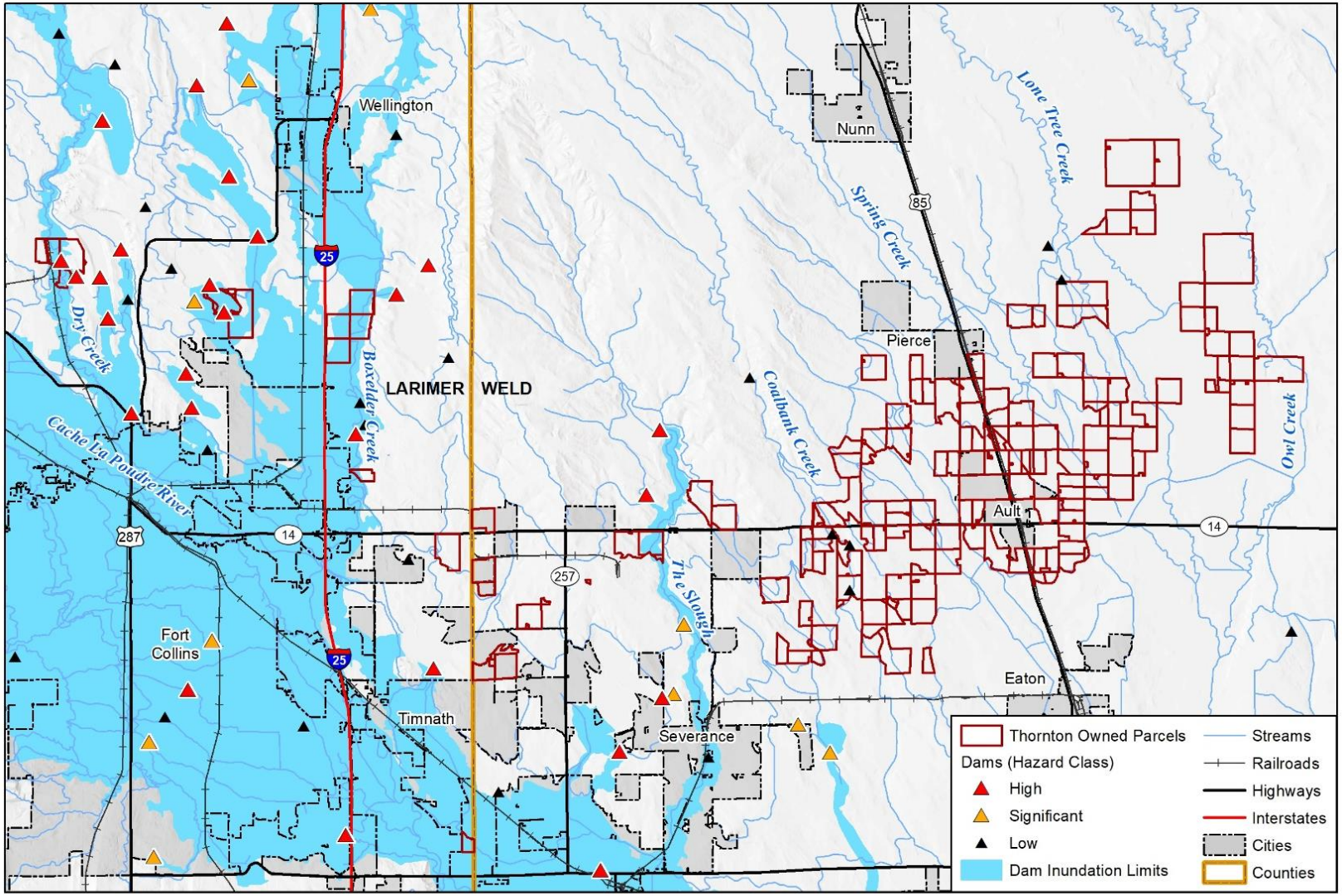


Figure I-4 Dam Inundation Zones in the Vicinity of Thornton-owned Parcels in Larimer and Weld Counties



Map compiled 12/2021;
intended for planning purposes only.
Data Source: Larimer and Weld County, CDOT, DWR

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