PLANNING FOR HAZARDS

Land Use Solutions for Colorado

January 2020

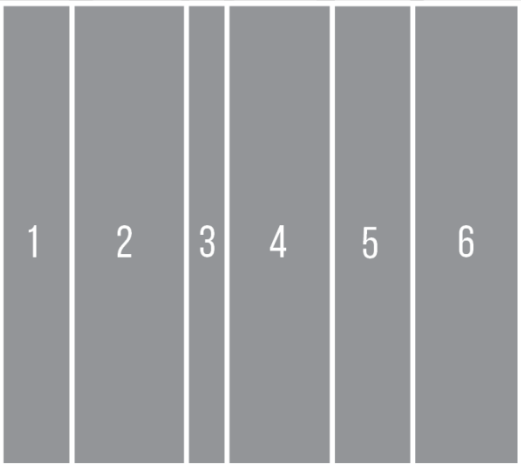

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Table of Contents

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Introduction and Summary

Overview

Planning for Hazards: Land Use Solutions for Colorado enables counties and municipalities to prepare for and mitigate multiple hazards by integrating resilience and hazard mitigation principles into plans, codes, and standards related to land use and the built environment. This guide provides detailed, Colorado-specific information about how to assess a community's risk level to hazards and how to implement numerous land use planning tools and strategies for reducing a community's risk.

Hazards are occurring more frequently in Colorado, and with greater severity. Experts believe this trend will continue; therefore, this guide helps Colorado to be more resilient and able to protect its residents and property from the devastating impacts of natural and human-caused hazards. This guide provides detailed descriptions of a range of land use planning mechanisms that can be used to reduce risk to hazards.

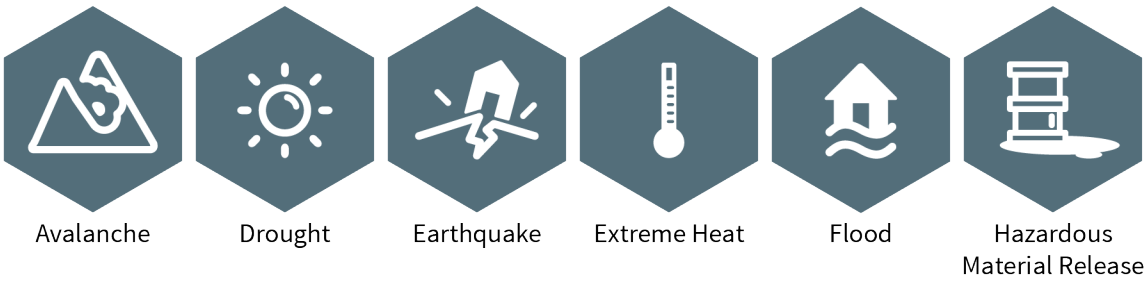
The Colorado Department of Local Affairs led the development of this guide, working with an Advisory Committee comprised of representatives from state and federal agencies, local government, and other subject-matter experts in hazard mitigation and land use planning. The Advisory Committee met three times throughout the course of the project and provided guidance and valuable input at critical milestones, identified key resources, and reviewed interim deliverables. The result is this guide that includes information from Colorado's leading experts on the subject, and represents varying community sizes, locations, and values.

How to Use the Guide

Description of the Guide Organization

The remainder of this guide is divided into the following chapters:

- **Chapter 2 - Planning Framework**. This sets the foundation for why and how land use planning can address hazards through various approaches.
- **Chapter 3 - Hazard Identification and Risk Assessment**. This chapter is a how-to guide for preparing the risk assessment. Detailed information on identifying which hazards might affect a particular community (including detailed descriptions for each hazard) is provided in the Appendix, *Hazards in Colorado*. The following hazards are addressed in this guide:



- **Chapter 4 - Planning Tools and Strategies**. Several categories of specific land use planning tools and strategies are explored, including individual profiles for each tool that describe what hazards the tool addresses, how to use the tool, and which communities have already implemented the tool. For many of the planning tools and strategies, model code language and commentary is provided to illustrate how to implement the various tools through regulatory mechanisms. A table summarizing all the planning tools and strategies profiled in this guide is included at the beginning of the *Planning Tools and Strategies* chapter. The tools are divided into the following categories:

Addressing hazards in plans and policies

- Comprehensive Plan
- Climate Plan
- Community Wildfire Protection Plan (CWPP)
- Hazard Mitigation Plan
- Parks and Open Space Plan
- Pre-Disaster Planning

Strengthening incentives

- Community Rating System
- Density Bonus
- Development Agreement
- Transfer of Development Rights (TDRs)

Protecting sensitive areas

- 1041 Regulations
- Cluster Subdivision
- Conservation Easement
- Land Acquisition

- Overlay Zoning
- Stream Buffers and Setbacks

Improving site development standards

- Stormwater Ordinance
- Site-Specific Assessment
- Subdivision and Site Design Standards
- Use-Specific Standards

Improving buildings and infrastructure

- Building Code
- Critical Infrastructure Protection
- Wildland-Urban Interface (WUI) Code

Enhancing administration and procedures

- Application Submittal Requirements
- Post-Disaster Building Moratorium

- **Chapter 5 - Moving Forward.** This chapter is focused on implementation and provides helpful tips and resources for communities to move the ball forward on assessing risk, working with the local residents, selecting appropriate tools and strategies, and identifying available funding and technical assistance sources.
- **Glossary, Bibliography, and Index.** These sections of the guide include key term definitions, a bibliography of resources used in the guide, and an index for easy cross-referencing.
- **Appendix: Hazards in Colorado.** This appendix describes the individual hazards that may affect communities in Colorado and includes information on related hazards and applicable data sources.

Because Colorado communities vary in how they approach land use planning, several contexts are explored throughout the guide using examples and best practices – from big city to small town, urban to rural settings, and Western Slope to Eastern Plains.

The Website Component

An essential component to this guide is the project website, www.planningforhazards.com. On this website, users may view the same information presented in this guide, supplemented over time with additional videos, links to resources, and new tools and strategies. From this website, users can choose to view the guide material "cover-to-cover," or navigate the site through a more targeted route based on the user's need for information. For example, a land use planner may be interested in specific tools applicable to mitigating wildfire. They can jump directly to that set of tools on the website rather than skimming the entire guide.

The Colorado Center for Sustainable Urbanism at the University of Colorado Denver will maintain this website to ensure that it remains relevant to Colorado communities and reflects new best practices as they develop, and to provide consistent website functionality.

planningforhazards.com

Planning Framework

Some of the most beautiful developable lands in Colorado also pose significant risk from hazards, such as dense forests with a high risk of wildfire, river corridors subject to frequent flooding, or hillsides at risk of landslide or rockfall. Many people are drawn to build homes and businesses in these attractive places, despite the potential loss of life and property.

The challenge for Colorado's local governments is to plan for appropriate development to occur while also protecting people and property from the impacts of hazards. Often the simplest way to ensure safer communities is to prohibit building in hazardous areas. However, stopping development altogether in high-risk areas is not always feasible, and planners and local officials must balance the protection of public health and safety with other important goals such as economic development and the provision of affordable workforce housing.

The sections below describe general approaches for mitigating hazards through land use planning and the general legal and regulatory framework for planning for hazards in Colorado.

Mitigating Hazards through Planning

Planning in Hazardous Areas: A Range of Approaches

The following general frameworks describe different approaches for local communities as they balance planning for hazards with other important land use goals.

- **Prevent development in hazardous areas.** An obvious solution for making communities safer is to avoid hazardous areas altogether, as discussed in the sidebar on the right. Communities can discourage or restrict development in vulnerable areas such as floodplains, landslide areas, the wildland-urban interface (WUI), or other known hazard areas. Avoiding hazardous areas can be accomplished through regulations (such as overlay zoning) or through incentives (such as cluster subdivisions). There are also non-regulatory approaches, such as land acquisition.
- **Direct future growth to safer areas.** Preventing development in hazardous locations is only part of the equation. Communities can also encourage growth in locations that are less vulnerable to natural hazards. Directing future growth requires that the community identify locations deemed suitable for development and redevelopment. This process often forms the core of future land use elements in comprehensive plans. Once safe areas have been identified, communities can back up those policy decisions by directing investment (such as capital improvements and schools) and removing barriers to developing in those areas.
- **Protect existing development in hazardous areas.** Avoiding hazard areas protects future development; however, protecting people, property, and facilities in already-developed areas is just as important. Strengthening existing development can be achieved through many land use and mitigation strategies, such as upgrading development standards to protect vulnerable areas (e.g., stronger floodplain regulations), requiring nonconforming properties to be brought into compliance with updated standards, updating building codes to promote safer development, and in some cases relocating existing structures to less-vulnerable areas.

Avoidance

The most effective way to protect development from hazards is simply to prohibit development in known hazard areas.

However, strictly prohibiting development in any area with a potential hazard can be not only logistically challenging, but often politically infeasible. Nevertheless, many of the tools and strategies discussed in this guide are designed to keep development out of harm's way through avoidance. They include:

- *Transfer of development rights*
- *Cluster subdivision*
- *Conservation easement*
- *Land acquisition*
- *Overlay zoning*
- *Stream buffers and setbacks*
- *Subdivision and site design standards*
- *Post-disaster building moratorium*

Each of these approaches provides possible solutions for Colorado communities looking to plan for or protect development from hazard risk. Most likely, a community will embrace a set of complementary approaches based on local circumstances. There are not necessarily bright lines between the approaches. Indeed, there is some overlap, and many of the

planning tools profiled in this guide may be used to support more than one objective. For example, a land acquisition strategy could be used to both restrict development in hazard-prone areas and also shift development to safer locations. The approaches should be evaluated for their potential effectiveness, and subsequent regulatory tools tailored to meet local needs.

The Interrelatedness of Natural Hazards

Natural hazards, like much of nature, are part of an interconnected, complex system. While most hazard events seemingly occur independently, they are often correlated and in some cases may greatly influence the probability, frequency, and magnitude of one another. This can be true even when specific hazard occurrences are separated by long distances or periods in time.

The interrelatedness of natural hazards is particularly evident in Colorado's semi-arid climate. As described in the *Colorado Resiliency Framework* (2015), three of the most significant hazards of concern in the state are linked together in what has been referred to as the "drought/fire/flood system" (p. 3-7). In this system, the reduced water and moisture availability in a drought increases risks related to wildfire through higher fuel loads (drier conditions, pest infestation, tree mortality, etc.). Severe wildfires can then leave slopes denuded of all vegetation and turn soils into hydrophobic surfaces, preventing rainfall from being absorbed into the ground and in turn rapidly increasing the amount of runoff from heavy rain events. These conditions drastically increase risks related to flash flooding, erosion, and mud/debris flows. As the pattern of these cascading natural hazards suggests, some of Colorado's most destructive flash flood events can ironically be linked to previous incidents of drought. Many of Colorado's past disaster events provide clear evidence of these direct relationships between drought, wildfire, and flood, including a recent series of destructive floods in the burn scar areas surrounding Colorado Springs.

While drought, wildfire, and flood hazards are more discernibly related, they are part of the same natural system with direct or indirect relationships to the risk levels for other hazards including extreme heat, severe winds, lightning, soil hazards, landslides, mud/debris flows, and rockfalls. Further, as described in the next section, the projected long-term effects of climate change are expected to influence the risk levels for most natural hazards in Colorado.

Destroyed vegetation after a wildfire.

Source: State Farm Insurance, 2010

Climate Change

The climate in Colorado is changing, in large part due to increasing levels of greenhouse gases (GHGs) in the atmosphere. The state is significantly warmer today compared to 50 years ago, with the average annual

temperature having increased 2.5 degrees Fahrenheit since 1965. Scientists estimate that the state will see an additional 2.5 to 5 degrees of warming by 2050 (*Colorado Climate Plan*, 2015). Already, past warming in Colorado has resulted in multiple hazards including faster and earlier snowmelt, longer and more severe droughts, and more frequent periods of extreme heat. Moving forward, climate change is expected to have significant impacts across multiple sectors of our state's economy.

Climate Change in Colorado –
An Interview with Taryn Finnessey

The climate in Colorado is changing, with important implications for local communities. To learn more about the science of climate change in Colorado, the project team interviewed Taryn Finnessey, Climate Change and Risk Management Specialist at the Colorado Water Conservation Board (CWCB).

Q: What is the climate change outlook for Colorado?

Temperatures in Colorado have risen, and we are anticipating an additional 2.5 degrees of warming by mid-century. Warming is really the driver that affects water availability, soil moisture, and evapotranspiration. All of those play a role in fire hazard, drought, and ecosystem and watershed health. Temperature has an impact on floods, both post-fire and post-drought. There are public health implications as a result of increased temperature and impacts on water quality and air quality.

Precipitation is a bit harder to pin down. Some models show precipitation increasing, some show it decreasing. Should we see a decrease in precipitation, it will further compound many of these issues. Even if precipitation stays the same, we will see a decrease in water availability because it will take incrementally more precipitation to overcome that warming signal.

Q: What other impacts should we expect to see from the changing climate?

One of the things we will see is an increase in water temperatures, which is obviously a concern for our cold-water fish species. We are also seeing a shift in earlier spring runoff by 1-3 weeks, separately from dust-on-snow events. These earlier peak runoffs result in lower late summer flows. In some areas, this means rivers are not flowing, which has implications for riparian habitats and fisheries. There is also concern about the spread of non-native species and disease across all ecosystems. These non-native species may be more competitive in regions that become too warm or that are changing too rapidly for native species to adapt.

***Taryn Finnessey** is a staff member at the Colorado Water Conservation Board and was formerly a water policy analyst for Western Resource Advocates. Climate Change in Colorado, released by the CWCB in August of 2014, is the scientific foundation for the Colorado Climate Plan. This interview was conducted in October 2015 by Andrew Rumbach (University of Colorado Denver). The interview has been condensed and edited.*

In 2013, the Colorado General Assembly passed House Bill 13-1293, which declared that climate change "presents serious, diverse, and ongoing issues for the state's people, economy, and environment." The State has since released several plans and reports focused on reducing the impacts of climate change, whether through mitigation (actions to reduce greenhouse gas emissions) or adaptation (actions to cope with change climate conditions). *The Colorado Climate Change Vulnerability Study* (2015), commissioned by the Colorado Energy Office, is an overview of key vulnerabilities of state resources to climate change. The *Colorado Climate Plan* (2015) is intended to promote state policy recommendations and actions that will help the state to mitigate greenhouse gas emissions and adapt to future climate change impacts. The *Colorado Climate Plan* follows the publication of the *Colorado Climate Action Plan* (2007), which focused largely on greenhouse gas mitigation.

Considering Community Context

The tools and strategies included in this guide come with an important caveat – one size does not fit all. A tool that is effective for one community may be less effective for another based on several factors discussed in this section. Understanding local context is essential to building support for land use decisions and achieving appropriate mitigation strategies. It is also important to recognize that the tools and strategies included in this guide are examples and best practices, and in many cases can be further tailored to fit within the local context. For example, a simpler Transfer of Development Rights (TDR) program can be developed for smaller communities with fewer staff to administer the program, rather than simply assuming that the tool will not work for that particular community.

Size and Geographic Location

Colorado communities range in population size, from large cities like Denver and Grand Junction, to small towns such as Buena Vista and Brush. Typically, larger communities have more local government staff and larger budgets. They may have more resources available to help plan for and manage the impacts from hazards. However, many small towns in Colorado are faced with the same hazard-related challenges as larger cities.

For example, the City of Boulder, with a population of 97,385 (*Boulder city*, 2010), and the City of Glenwood Springs, with a population of 9,614 (*Glenwood Springs city*, 2010), are both nestled in the foothills. Both cities have significant development pressure in the Wildland-Urban Interface (WUI), and each has experienced devastating wildfires in the past decade. While the geographic extent of the Boulder restrictions will be broader given the community's larger size, the two communities may implement similar programs and land use tools for wildfire mitigation, such as adopting restrictions on hillside development.

Another important factor to consider is geographic location. Colorado is divided into several climates and ecologies, each with a unique set of challenges related to natural hazards. For example, tornados and extreme drought conditions on the Eastern Plains are often not present or are less severe in higher alpine communities. Geographic location can also influence factors such as political palatability of a particular strategy, cost to implement mitigation actions, and effectiveness of a particular tool based on local conditions.

Boulder is a much larger community than Glenwood Springs, yet both have similar planning issues related to significant development pressure in the WUI.

Source: Nelson Sirlin, 2016

Technical, Administrative, and Financial Capacity

A program or tool is only effective if it is consistently administered and enforced. For example, landscaping maintenance standards are an appropriate mechanism for reducing fuel load in wildfire-prone areas. However, without dedicated staff or other resources to

enforce those standards, compliance will be limited. It is important for any community considering a new planning tool or strategy to evaluate:

- **Technical capability.** Does the community have the technical understanding or immediate access to training necessary to adequately administer the program or tool?
- **Administrative resources.** Would administration of the strategy or tool require additional employees or contractors?
- **Financial capacity.** What are the costs to administer and maintain the proposed strategy or tool? What resources are available (both internal and external) to help implement the tool?

Community Goals and Political Will

In addition to quantifiable factors such as human and financial resources, communities must also evaluate whether or not a proposed tool or strategy is aligned with the community's values and political environment. A good comprehensive plan will clearly identify the community's goals and vision for the future. That makes it easier to build support for initiatives that are in tune with such stated values. However, in the absence of clear direction, communities (and often land use planners) have to test the waters through public forums, interaction with elected and appointed officials, and stakeholder interviews before estimating the feasibility of adopting a new tool or strategy in the community.

It is important to understand the local nuances to build a more effective case for land use planning and hazard mitigation. For example, if a community is continually pushing tree preservation as a top priority, then promoting defensible space standards (which typically involve thinning fuels) would require proactive discussion on how to both preserve the forest while also protecting people and structures from wildfire risk.

Another consideration related to the political environment is the general comfort level for policy versus regulation and incentive versus regulation. For example, if the current political climate is actively promoting incentives for development and is adverse to additional regulatory tools, then planners can explore a different set of strategies for mitigating hazards (e.g., density bonuses that encourage conservation in lieu of an overlay zone that prohibits development).

A community stakeholder meeting.

Source: Clarion Associates

In sum, the size, location, resources, and policy goals of a community all influence the degree and extent to which it should embrace the particular planning tools described in this guide. Each tool should be tailored according to the local context, particularly in terms of resources available for long-term maintenance, enforceability,

and administration. Answering these questions is not always clear-cut. Thoughtful consideration should be given to how a new program or tool might also impact other current policies and regulations, how other departments or agencies may be impacted, and whether additional funding mechanisms should be pursued.

Land Use Planning and Regulation in Colorado

Defensible land use regulations must be supported by appropriate enabling authority. This section discusses the general legal framework for land use planning in Colorado, including regulating for hazards. The section also describes the local framework for mitigation planning and identifies state policies and programs that help bolster the state's commitment to hazard mitigation.

Enabling Legislation and Authority

Colorado is a "local control" state when it comes to land use planning authority (*Local Government*, 2012). This means that most land use decisions such as adoption of zoning and building codes are driven by local governments, not by the state. The State of Colorado designates land use authority to local governments through several key pieces of enabling legislation, including:

- **Local Government Land Use Control Enabling Act** (C.R.S. § 29-20-101, et. seq.). This act grants counties and municipalities the authority to plan for and regulate the use of land within their jurisdiction, specifically including the regulation of development and activities in hazardous areas.
- **Home Rule Powers** (Articles XX and XIV of the Colorado Constitution). More than one-third of Colorado municipalities are classified as "home rule." This means that those local governments are able to draw upon any authority delegated by the General Assembly, and also any additional authority from their locally-adopted home rule charter. There are some limitations, including the ability to supersede state statutes only when the matter is of local concern. Municipalities and counties that are not classified as home rule must abide by the authority granted through state statutes.
- **Master Plans** (C.R.S. § 30-28-106 and § 31-23-206). Colorado counties and municipalities are authorized to prepare master plans (commonly known as "comprehensive plans") to plan for the physical development of their community. Unlike many other states, there are few mandates for the content or format of comprehensive plans. As discussed later in this guide, Colorado communities can address hazard mitigation in the comprehensive plan through various mechanisms.
- **Zoning** (C.R.S. § 30-28-111 and § 31-23-301). The state authorizes Colorado communities to adopt local zoning regulations to promote the health, safety, morals, and general welfare of residents. Zoning is a common tool used for protecting current and future development from hazard areas. Zoning is related to and may be somewhat restricted by other state and federal laws, such as in the areas of telecommunications, signs, religious institutions, and treatment of protected classes.

- **Areas and Activities of State Interest** (C.R.S. § 24-65.1-101). Colorado communities are permitted to identify, designate, and regulate areas and activities with statewide impacts such as natural hazard areas, site selection of airports, mass transit facilities, and development of new communities. Commonly known as "1041 regulations" (after the enabling act, HB 1041), these regulations allow local governments to retain control and develop permitting procedures and standards for development.

Local Hazard Mitigation Plans

Colorado communities can integrate land use planning and mitigation by using the information contained in Local Hazard Mitigation Plans, adopted locally and approved by FEMA. Local Hazard Mitigation Plans consolidate hazard-related information prepared by a municipality, county, or region, including the assessment of potential hazards and risk, identification of vulnerable populations, and development of mitigation strategies. Although the development of Local Hazard Mitigation Plans is commonly led by emergency management and public safety personnel, planners are becoming increasingly involved in the process. These plans, which make the projects identified therein eligible for a variety of grant funds related to hazard mitigation, are discussed in further detail later in this guide in the planning tool profile for the *Local Hazard Mitigation Plan*.

Comprehensive Planning

Communities can lay the foundation for hazard mitigation strategies and implementation tools through their comprehensive plans. Integrating planning policies with other hazard mitigation tools is discussed in greater detail in a later section on *Addressing Hazards in Plans and Policies.*

Resilience

Colorado communities are constantly striving to improve quality of life, economic opportunity, high quality education, and access to resources for their residents. However, communities may be vulnerable to shocks (large, disruptive events that cause significant immediate damage, injuries and deaths, or result in sudden changes in the community) and stresses (chronic conditions that magnify vulnerability and make it harder to recover from shocks) that can greatly impede their goals.

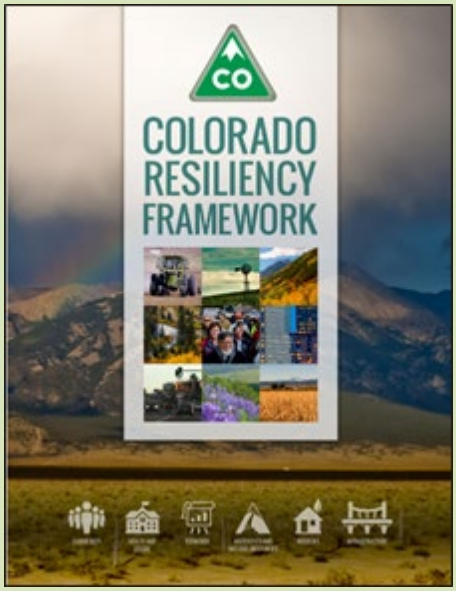
The majority of hazards described in this guide cause major shocks to a community. Reducing the risk to such events greatly increases a community's resilience. Long-term stresses such as drought – as well as economic and social stresses such as high unemployment, housing shortages, or polluted waterways – should also be addressed in order to make the community better able to withstand unknown future conditions. All of these community risks should be assessed and strategies developed to improve the resilience of a community to these potential risks. Land use policies and regulations can play a valuable role in reducing and avoiding risk.

To reduce these risks, communities should assess what makes them more or less resilient to shocks and stresses, develop partnerships and engage community networks, develop a vision for resilience, and then implement this vision in plans, policies, and projects.

In May 2015, Governor Hickenlooper adopted the Colorado Resiliency Framework, documenting Colorado's commitment to and investment in a resilient future. Resilience is defined in the Framework as "the ability of communities to rebound, positively adapt to, or thrive amidst changing conditions or challenges – including disasters and climate change – and maintain quality of life, healthy growth, durable systems, and conservation of resources for present and future generations."

The framework identifies Colorado's most pressing challenges for risk and vulnerability and establishes clear goals and strategies to improve resiliency in several sectors including community, economy, health and society, housing, infrastructure, and watersheds and natural resources. The framework includes recommendations and implementation actions that the State and local governments can take to make Colorado more resilient to shocks and stresses.

Learn more about the Colorado Resiliency Framework (2015) on the "Colorado United" website: sites.google.com/a/state.co.us/coloradounited.



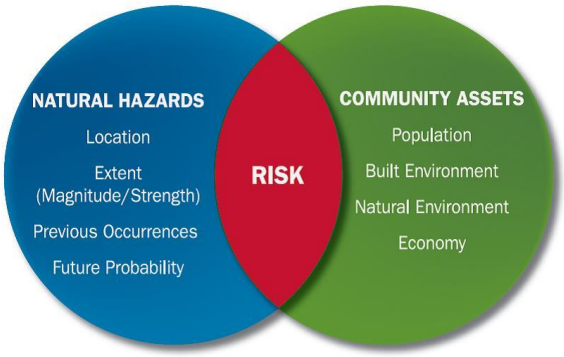
Hazard Identification and Risk Assessment

Developing strategies and implementation tools for mitigating hazards first requires an evaluation of a community's risk and vulnerability to particular hazards. This chapter provides information on the various hazards that affect Colorado communities, the fundamental steps involved in assessing risk and vulnerability to those hazards, and tips for effectively applying the results of a risk assessment. The procedures outlined in this chapter are often referred to as the Hazard Identification and Risk Assessment (HIRA) Process. Common data sources are summarized at the end of this chapter in *Summary of Common Hazard Data Sources.*

How Do I Assess Local Risks from Hazards?

What is "Risk?"

Hazards are part of the world around us and their occurrence is inevitable. Floods, landslides, wildfires, windstorms, and other hazardous events are natural phenomena in Colorado over which humans have limited control. These events result in periodic damage to the environment: fire can destroy forests, floods can erode stream banks and result in channel migration, and a host of geologic hazards can severely alter the natural landscape. However, despite their destructiveness, these occurrences are not unexpected, and can even reflect healthy regeneration of natural systems.



FEMA uses this Venn diagram to illustrate the concept of risk as the relationship, or overlap, between hazards and community assets (modified from USGS and Oregon Partnership for Disaster Resilience Models).

Source: FEMA, Local Hazard Mitigation Handbook (2013)
fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf

It is only when the human environment intersects with these natural phenomena that a hazard risk is created and a so-called "natural disaster" may result. A disaster occurs when human settlement and infrastructure, such as buildings and roads, exists in the path of the forces of nature, resulting in potentially hazardous situations. Our built environment is not nearly as recuperative or resilient as the natural one. A hazard can result in physical damage, economic disruption, and other significant impacts to an entire community for many years following the event.

Disasters can also occur as a result of human activity, such as the storage or movement of hazardous chemicals, regardless of natural conditions. While the source or cause of risk and disasters may be natural or human-caused, this planning guide focuses primarily on Colorado's most significant *natural* hazards.

While we cannot prevent natural hazards, we do have some means to anticipate their occurrence and manage what comes afterward—and we certainly can minimize the risk from human-caused hazards. Local planners in particular have a range of tools and techniques to minimize or avoid the potential adverse consequences from foreseeable hazards. The focus of this guide is to assist citizens in planning ahead before a hazard event occurs, so that communities can lessen risk and hopefully prevent hazardous events from becoming disasters.

Conducting a Risk Assessment

The first step in preparing for hazards is to conduct a local risk assessment, which helps identify the potential impacts of hazards on a community's physical, social, economic, and environmental assets. When done correctly, the assessment helps decision makers and stakeholders understand the most locally significant hazards and unique risks, including current and possible future vulnerabilities. Just as important, the risk assessment supports the development of mitigation measures to reduce future risk. While specific approaches may vary depending on available capabilities and resources, the outcome, conclusion, or end goal of any meaningful risk assessment should be implementation of the community's risk reduction and mitigation strategies.

The FEMA-Recommended Steps for Risk Assessment

Since 2001, more than 27,000 communities across the United States have conducted local risk assessments in compliance with federal regulations per the Disaster Mitigation Act of 2000. Although there are many methods to identify and assess local hazard risks, most generally follow the same key steps and result in similar types of information. The current standard process typically used by Colorado communities follows guidelines issued by FEMA and the Colorado Division of Homeland Security and Emergency Management. There are four recommended steps, as described below. Detailed guidance for completing each step is provided in FEMA's *Local Mitigation Planning Handbook* (2013).

- **Step 1: Describe Hazards.** Identify hazards that may affect the community. Describe the type, location, extent, previous occurrences, and probability of future events.
- **Step 2: Identify Community Assets.** Identify the community's assets at risk to hazards. Assets may be categorized generally as people, economy, built environment, and natural environment.
- **Step 3: Analyze Risks.** Evaluate vulnerable assets, describing potential impacts and estimating losses for each hazard through exposure analysis, historical analysis, and/or scenario analysis.

- **Step 4: Summarize Vulnerability.** Document and summarize the community's most significant hazard risks and vulnerabilities in order to inform the mitigation strategy.

Involving Everyone in Risk Assessment
Identifying local hazards and assessing risk requires input from a number of stakeholders and data from a variety of sources. This will include plans and personnel that might not immediately come to mind.

A collaborative, multi-sector, inclusive process is necessary. For example, a risk assessment should engage fire service and emergency managers, community planners, city engineers, law enforcement, regulators, natural resource and/or hazard experts (geologists, foresters, hydrologists, floodplain managers, fire behavior analysts, etc.), GIS specialists, community leaders, local residents, community organizations, and others. Similarly, data sources may include the Local Hazard Mitigation Plan, emergency management plan, comprehensive/master plan, hazard-specific plans and historical data, critical infrastructure plans, census information, and any other resources that help describe the hazard and identify community assets (or "values at risk").

Some information is not up for debate—historical analyses of flood or fire, for example, is factual. Other inputs, including values and estimated losses, can become more subjective. While finding consensus may be difficult, the process of engaging multiple stakeholders ensures that everyone better understands the risk assessment outcomes and is better prepared to help prioritize mitigation efforts. Building these relationships before a disaster occurs will also pay dividends during and after the disaster.

Developing Your Own Local Risk Assessment

Early in developing a risk assessment, planners should collect and review local sources that have already addressed local hazards. The sources will likely be many and varied in terms of their relevance, accuracy, and usefulness, so the first key action is to collect and review what is readily available. This may include emergency operations plans, comprehensive plans, natural resource plans, or hazard-specific plans (e.g., floodplain management plans, community wildfire protection plans) if available, as well as any other technical reports or studies.

Planners should also consult local emergency manager(s) at the municipal and/or county level. These officials will be familiar with local hazard risks and will likely have a wealth of local data, including information on past hazard events and previously completed hazard analyses and risk assessments. They will also have other recommended local contacts such as floodplain administrators, engineers, and building code officials. Another primary source to consult is the State Hazard Mitigation Officer (SHMO) at the Colorado Division of Homeland Security & Emergency Management, who will be familiar with the latest risk assessment resources for Colorado communities and also maintains a statewide risk assessment as part of the *Colorado Natural Hazards Mitigation Plan* (2013).

Many additional existing resources that describe Colorado hazards are described later in this guide in the *hazard profiles in the appendix*. Assessing local hazard risks is a continuous process that should be driven by ongoing coordination among local community staff and stakeholders. While FEMA-approved Local Hazard Mitigation Plans are required to go through regular updates every five years, Colorado communities are encouraged to be proactive with more frequent and routine assessments of local hazards as new information or resources become available.

We Don't Have GIS. How Can We Map our Hazard Risk?

For many communities in Colorado, the use of GIS is either cost-prohibitive or otherwise limited by resources or expertise. There are several options to explore to help communities establish a more robust spatial analysis of hazards without the use of GIS.

1. ***Contact the state.*** *The Division of Homeland Security and Emergency Management is familiar with available mapping resources, and can point communities in the right direction to locate already existing maps. Contact the local hazard mitigation planning program manager at dhsem.state.co.us/emergency-management/mitigation-recovery*
2. ***Generate free maps online.*** *Link to online resources that provide free data, and many of them can be mapped to the region or even local level depending on the hazard. One example: EPA's MARPLOT, which is the mapping program for the CAMEO software suite, which is used widely to plan for and respond to chemical emergencies. Learn more about the CAMEO software suite at epa.gov/cameo/marplot-software.*
3. ***Establish an IGA for shared GIS services.*** *Working with a neighboring municipality or county that is already equipped with GIS can be an efficient and affordable way to secure accurate hazard mapping analysis. An intergovernmental agreement (IGA) can define the parameters of the work, assign responsibilities, and establish requirements for any monetary contributions.*
4. ***Contact a University.*** *Undergraduate or graduate programs in urban planning or geography may have students or classes interested in assisting with your hazard identification and risk assessment mapping needs.*

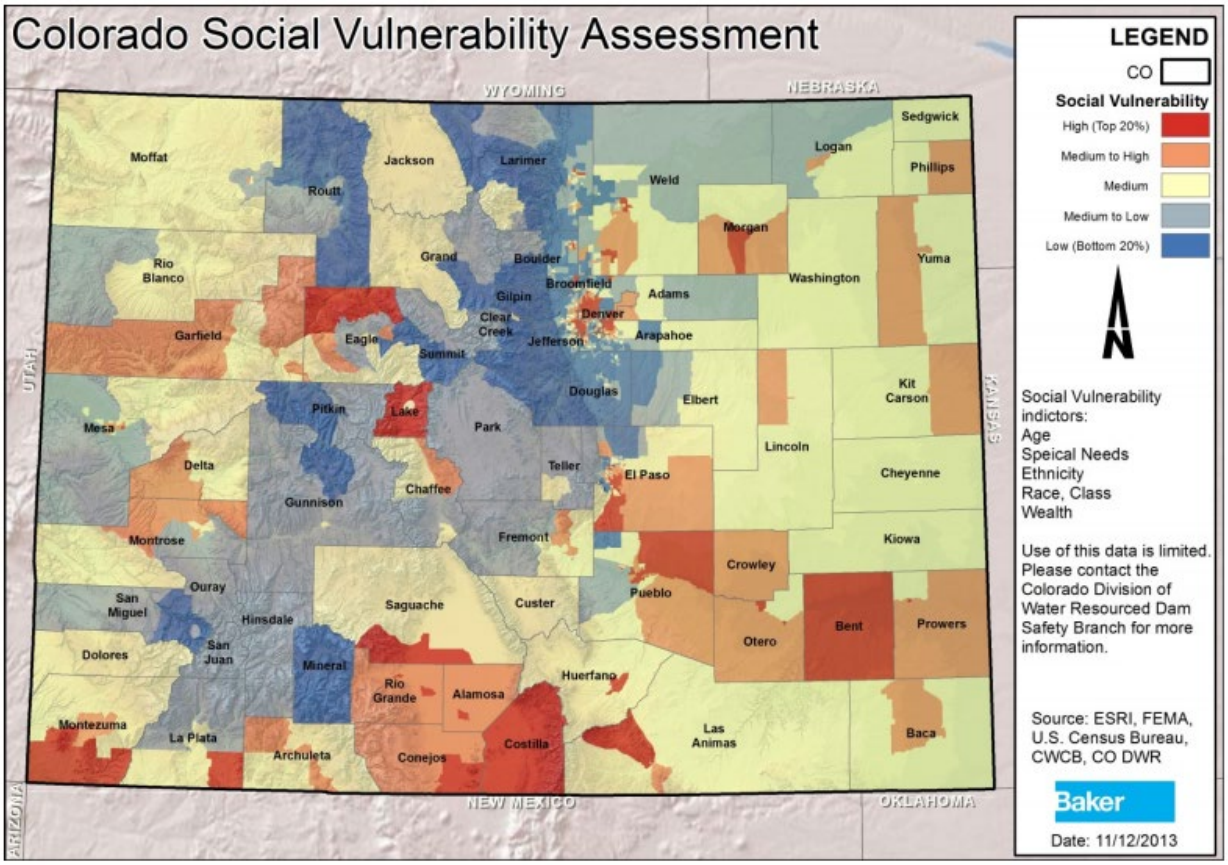
Assessing Vulnerable Populations

Another important element of the risk assessment is identifying any particularly vulnerable populations in the community. The consequences of a disaster event extend well beyond physical damages, often causing or amplifying human suffering, economic loss, and social disruption. This is especially true for those who may not easily access the resources typically offered to assist with individual actions before, during, or after an emergency or disaster event.

These vulnerable populations may include children, the elderly, the physically or mentally disabled, non-English speakers, or the medically or chemically dependent. They may include those in low-to-moderate income households with limited mobility or means to pay for personal protections such as insurance or other risk mitigation activities, and even more limited means to cover disaster losses. They may also include transient populations such as students, homeless, migrant farm workers, and visitors that may be less familiar with local hazards and less prepared to protect themselves during an event.

A variety of data sources are available to help collect and assess the demographic and socioeconomic characteristics of people within the community, particularly statistical data provided by the U.S. Census Bureau at the tract, block group, and block levels. Similar to the way in which data on buildings, infrastructure, and critical facilities are used to assess the potential exposure of physical assets to hazard risks, census data can be used to identify and analyze vulnerable populations. Although methods vary, one widely recognized and replicated approach is the Social Vulnerability Index (SoVI®) developed by the University of South Carolina's Hazards & Vulnerability Research Institute. The index is a comparative metric that synthesizes 30 variables, primarily from census data, that research suggests

contribute to increased social vulnerability. An example of a Colorado application of the SoVI® technique is shown below.



Using the Social Vulnerability Index, the Colorado Division of Water Resources Dam Safety Branch conducted a Colorado social vulnerability analysis at the census-tract level. Local socioeconomic and demographic data were used to identify spatial patterns in social vulnerability across the state and have been applied to the hazards identified in the Colorado Natural Hazards Mitigation Plan. The tan and red areas reflect higher social vulnerability, and the yellow and blue areas reflect lower social vulnerability.

Source: Colorado Natural Hazards Mitigation Plan (2013)
dhsem.state.co.us/sites/default/files/2013%20Colorado%20Natural%20Hazards%20Mitigation%20Plan%20-%20Final.pdf

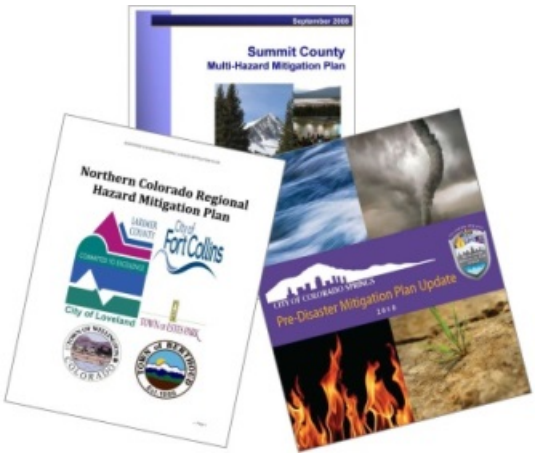
Regardless of the approach, the outcome of assessing vulnerable populations should be the identification of people most susceptible to harm and loss from hazards, as well as information that can be used to reduce vulnerability. In addition to resident locations, facilities that house or support people with functional needs such as medical care facilities, nursing homes, daycares, and others should be considered. Whether through illustrative maps, data tables, or simply a listing of particular locations or segments of the population, the objective is to ensure that specific vulnerabilities are incorporated in the risk assessment and addressed in the mitigation strategy.

Local Hazard Mitigation Plans

What Are Local Hazard Mitigation Plans and Why Are They Important?

Local Hazard Mitigation Plans consolidate all the hazard-related information prepared by the community, including descriptions of potential hazards, risk assessments, identification of vulnerable populations, and mitigation strategies.

As of August 2015, 75 percent of Colorado's 64 counties have an approved local mitigation plan (*Region VIII*, 2015). Because these plans expire after five years, the number of jurisdictions covered by an active plan fluctuates annually. Local Hazard Mitigation Plans are typically completed at the county scale, though some are completed by municipalities (e.g., the cities of Aurora, Boulder, Colorado Springs, Denver, and Westminster) or special districts (e.g., South Metro Fire Protection District). Occasionally, multiple jurisdictions collaborate to prepare regional mitigation plans; examples include plans adopted by the Denver Regional Council of Governments (Adams, Arapahoe, Broomfield, Clear Creek, Douglas, Gilpin counties and the City and County of Denver), and counties in Northeast Colorado (Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington, Weld, and Yuma counties). FEMA guidance has become more strict in recent years, requiring greater detail as to the unique vulnerabilities and specific mitigation solutions for each city and town that participates in a plan, which has resulted in more active municipal participation in the creation of county-wide plans and a greater number of single-jurisdiction plans.



Cover images of the Summit County, Northern Colorado, and City of Colorado Springs Local Hazard Mitigation Plans.

Source: Adapted by Clarion Associates

The development of a Local Hazard Mitigation Plan provides an excellent opportunity for intergovernmental collaboration, in which planners, emergency managers, engineers, public works, and other local and regional officials can jointly develop complementary policies and actions. For example, Manitou Springs is currently preparing a new hazard mitigation plan in conjunction with a new comprehensive plan, which will help link land use decision-making and natural hazard risk reduction.

Action #	Mitigation Action Description	Hazard	Responsible Agency
Objective A: Identify and initiate improvements to public safety, response, and recovery programs to reduce risk and vulnerability.			
A-1	Upgrade aging infrastructure such as transportation, drainage, utilities, and others that could be affected during a major natural disaster.	All Hazards	OEM, CSU, and Engineering
A-2	Evaluate repetitive loss properties and potential solutions to mitigate existing conditions.	Flood	OEM, PPRBD
A-3	Update and maintain the Jimmy Camp Creek and Cottonwood Creek Drainage Basin Planning Studies.	Flood	Engineering
A-4	Evaluate funding alternatives to achieve United States Army Corps of Engineers (USACE) certification of the Templeton Gap Floodway (levee).	Flood, Dam & Levee Failure	Engineering
Objective B: Follow through with and leverage existing organizations, programs, and procedures to implement the PDM Program.			
B-1	Continue to expand the capabilities and participation of the Emergency Management Committee and Volunteer Committee.	All Hazards	OEM
B-2	Develop a strategy to integrate the PDM plan with the City's strategic plan and other long-term planning documents.	All Hazards	Planning
B-3	Complete GIS and other automated inventories for stormwater, problem drainage areas, DFIRM and other City assets.	Flood	Engineering
B-4	Coordinate with Colorado Springs Utilities to review their current water conservation and drought programs.	Drought	CSU and OEM

This excerpt from the City of Colorado Springs mitigation strategy summarizes mitigation actions by hazard and responsible agency. Additional details are provided in a plan appendix.

Source: City of Colorado Springs. Pre-Disaster Mitigation Plan Update, Chapter 5, 2010
dhsem.state.co.us/sites/default/files/City%20of%20Colorado%20Springs%2010.2010.pdf

Is Our Jurisdiction Covered by a FEMA-Approved Local Hazard Mitigation Plan?

Information on jurisdictions currently covered by a Local Hazard Mitigation Plan can be accessed in several ways. To find out which jurisdictions are covered by a FEMA-approved Local Hazard Mitigation Plan:

- **Contact your local emergency manager.**

  A list of Colorado's emergency managers, by county, is provided here: dhsem.state.co.us/emergency-management/local-emergency-managers. Local emergency managers are most familiar with the current status of any mitigation planning efforts (either completed or underway) and are knowledgeable on how best to become involved in a future mitigation planning process.

- **Visit the State of Colorado's Division of Homeland Security & Emergency Management webpage on Regional and Local Hazard Mitigation Plans.**

  dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/regional-local-hazard-mitigation-plans. This site lists the status of FEMA-approved mitigation

plans in the state. The site also provides quick links to each mitigation plan, if available electronically.

- **Contact your regional or statewide contacts for mitigation programs.**
  Visit dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation for access to the State Hazard Mitigation Officer, the Mitigation Planning Program Manager, and regional contacts for specific areas across the state. These resources have access to up-to-date status reports on a particular jurisdiction's FEMA-approved mitigation plan.

What Hazards May Affect My Community?

This guide describes the individual hazards that may affect communities in Colorado. Each hazard is described in further detail in the appendix and includes the following elements:

- **A description of the hazard.** The description of each hazard includes a definition and general background information.
- **A description of the hazard's presence in Colorado.** This includes information on the history and severity of the hazard in Colorado communities.
- **A summary of related hazards.** Many of the hazards described in this guide can cause other hazards to occur, or can be exacerbated by the presence of other hazards.
- **Assessing the risk for certain hazards.** For some of the hazards, there are unique challenges associated with preparing risk assessments. This subsection addresses those challenges by presenting alternative approaches and methodologies.
- **Appropriate data sources for establishing a basis for a risk assessment.** Colorado communities have access to several sources of data for identifying hazard areas and determining vulnerability to each hazard. This component includes primary resources for preparing risk assessments. Some of the data sources are applicable to multiple hazards.
- **Applicable planning tools and strategies.** References to applicable tools and strategies that are profiled in the Chapter 4, *Planning Tools and Strategies*.

Summary of Common Hazard Data Sources

The table below summarizes the resources mentioned throughout this chapter that are applicable to multiple hazards.

	Avalanche	Drought	Earthquake	Flood	Hazardous Materials	Extreme Heat	Landslide / Rockfall	Soil Hazards	Wildfire	Wind	Winter Storm
Colorado Climate Center		✓		✓						✓	✓
Colorado Geological Survey			✓				✓	✓			
Colorado Natural Hazards Mitigation Plan	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Department of Homeland Security – Ready.gov	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Federal Emergency Management Agency			✓	✓		✓			✓	✓	
National Centers for Environmental Information		✓								✓	✓
National Weather Service						✓				✓	✓
United States Geological Survey			✓				✓				

Colorado Climate Center

The Colorado Climate Center is housed in the Department of Atmospheric Science at Colorado State University. It is a source of useful information on natural hazards in Colorado and provides an excellent resource to learn about climate in Colorado. ccc.atmos.colostate.edu

Colorado Geological Survey

The Colorado Geological Survey is the primary State agency for providing information and maps on geologic hazards such as landslides, mud/debris flows, rockfall, and soil hazards. coloradogeologicalsurvey.org

Colorado Hazard Mapping & Risk MAP Portal

The Colorado Water Conservation Board (CWCB) hosts this website as a portal to view information for the Colorado Hazard Mapping Program and, in the future, Colorado's Risk MAP Program. The Colorado Hazard Mapping Program provides a mitigation and land use framework for areas likely to be impacted by flooding, erosion, and debris flow. The Risk MAP Program delivers quality data to increase public awareness and lead to actions that reduce risk to life and property. The interactive map component of the website allows the user to click on area-specific activities and projects. coloradohazardmapping.com

Colorado Natural Hazards Mitigation Plan

The *Colorado Natural Hazards Mitigation Plan* is the State's FEMA-approved plan that serves as a foundation for the State's program to reduce risks to people, property, and infrastructure from natural hazards. The Plan is administered and updated by the Colorado Division of Homeland Security and Emergency Management. dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan

Department of Homeland Security – Ready Campaign

The Department of Homeland Security (DHS) launched the *Ready* in February 2003 as a national public service advertising campaign to provide education related to preparation and response to natural and man-made disasters. Although the focus of the site is on preparedness and response, the site provides ample information about the types of hazards that may affect communities around the country. ready.gov

Federal Emergency Management Agency

FEMA provides information related to hazard mitigation planning, including identifying hazards and preparing a risk assessment. fema.gov/hazard-mitigation-planning-resources

National Centers for Environmental Information

The National Centers for Environmental Information (NCEI) was formed in 2015 as a merger of NOAA's three existing National Data Centers: the National Climatic Data Center (NCDC), the National Geophysical Data Center, and the National Oceanographic Data Center. NCEI is where storm event data previously collected by NCDC is now provided. This is a rich data source for climate and historical weather information. This site contains historical event data on a host of natural hazards. ncdc.noaa.gov/stormevents

National Weather Service

The National Weather Service (NWS) is the official provider of U.S. weather, marine, fire, and aviation forecasts. The NWS issues warnings and provides data, products, forecasts, and information related to meteorology. The NWS is a component of the National Oceanic and Atmospheric Administration (NOAA). The NWS maintains a glossary of information on more than 2,000 terms, phrases, and abbreviations used by the NWS. weather.gov/glossary

United States Geological Survey

The United States Geological Survey (USGS) is the primary federal reference for national data regarding landslide and earthquake hazards. usgs.gov/natural_hazards

Planning Tools and Strategies

Building on the previous chapter, *Hazard Identification and Risk Assessment*, this chapter examines various land use planning tools and strategies that can be used to mitigate hazards. The first section provides general tips for applying the risk assessment results to planning. The remainder of the chapter focuses on specific planning tools and strategies aimed at reducing risk and mitigating hazards.

How Do I Apply Risk Assessment Results to Planning?

Capitalize on Opportunity

There are a range of options to increase the general awareness of hazards in a community. It is important to communicate hazard risk to citizens, elected officials, and other stakeholders, as well as integrate hazard mitigation principles into local plans, policies, and codes. As previously mentioned, Colorado communities are encouraged to be "opportunistic" and proactive by conducting more frequent and routine assessments of local hazards as new information or resources become available. Planners should look for opportunities to better leverage, streamline, and integrate these planning resources.

Opportunities to integrate land use and hazard planning include the development or update of an existing comprehensive plan, zoning ordinance, capital improvements plan, or other relevant processes. This includes but should not be limited to the maintenance of the adopted Local Hazard Mitigation Plan, as communities should constantly be seeking ways to capitalize on establishing synergies between it and other planning processes. Another notable opportunity includes the unique but often unforeseeable period following a damaging hazard event—a time when community stakeholders are typically much more engaged in the dialogue regarding surrounding community recovery and redevelopment decisions regarding infrastructure and other repairs. Colorado planners and local officials should be proactive by preparing plans or frameworks to help prepare for potential disasters and guide the post-disaster process.

Opportunistic Communities

Communicating risk to the community means developing a proactive strategy to outreach and education, and taking advantage of existing opportunities to "get the word out." To increase the awareness of hazards in a community, consider piggybacking on the following opportunities:

- *Comprehensive Plan Update*
- *Local Hazard Mitigation Plan*
- *Statewide awareness weeks, such as "Colorado Flood Safety and Wildfire Awareness Week"*
- *Regular updates to appointed and elected officials*
- *Redevelopment discussions following a damaging hazard event*

Communities should also seek to piggyback on other relevant state, regional, and local efforts to increase hazards awareness and promote risk reduction activities,

such as *Colorado Flood Safety and Wildfire Awareness Week*, or perhaps following the release of new scientific data relating to disasters or hazards management. Often during these times, the media, elected officials, and residents are more engaged and apt to join the conversation.

Another important opportunity is to consider how redevelopment efforts following a hazard event can be implemented to be more resilient, leaving the community better off than it was before the event. This effort requires careful coordination with community leaders, city departments, and other stakeholders through the community such as business owners, residents, and developers. Following an event, the community can begin a dialogue about long-term resilience.

Communication Tips

Once preparation of the Hazard Identification and Risk Assessment (HIRA) is complete, following the procedures outlined earlier in the chapter *Hazard Identification and Risk Assessment*, it is essential to use that information to the fullest extent possible. Begin by communicating the results of the HIRA and opportunities for mitigation extensively both internally and externally to the community. This will allow community members to understand and contribute to the development or refinement of mitigation actions to address identified risks. Although the risk assessment is a key component to any FEMA-approved Local Hazard Mitigation Plan, the use of risk assessment data should not be limited to that effort. From an emergency management and hazard mitigation perspective, the HIRA should be used to formulate specific mitigation actions that respond to the risks identified. While these actions have traditionally focused on education and infrastructure projects, they should be expanded to land use programs, policies, and regulations.

- **Think Comprehensively About Stakeholders**

  Planners and emergency managers should consider any potential impacts to other departments and other stakeholders as a result of the HIRA and start drawing connections to relevant policies, goals, or objectives of a particular audience. Make a point of regularly discussing coordination between emergency management and planning. Never assume that a department, agency, or group of individuals would not be interested in or affected by the results of the HIRA. Rather, communicate compelling synergies with their other projects or concerns. For example, alert the parks and recreation department of any spatial analysis of risk that could impact future acquisitions or trail connections, and engage representatives of potentially vulnerable populations.

- **Communicate Early and Often with Elected and Appointed Officials**

  Making an argument that a development application should be denied based on a particular hazard risk during the final approval hearing could be ineffective if the elected body is just learning of the risk. For communities with hazard risks that could impact major decisions, planners and emergency managers should make a point to regularly discuss the topic with appointed and elected officials. Keep it short, keep it

interesting, and continue to ask for their support on hazard mitigation efforts. When decision-makers are well informed, they make decisions with confidence. Community leaders should also adopt policies—especially in the comprehensive plan—and regulations that clearly communicate the risk to the community, including current and future property owners. Planners should use relevant facts from the community and explain why hazard mitigation is important. For example, how does hazard mitigation tie into other policies such as economic development and public safety? Incorporate tours, guest speakers, and best practices whenever possible. Back it up with relevant facts from the community (such as how damage from hazards could affect local tourism).

- **Don't Forget the Public**

  Hazard mitigation can be a component of any community project. Don't wait to begin engaging the public in a conversation about risk. Proven strategies like press releases, open houses, workshops, and websites can be effective tools for informing the public and initiating community conversations. Informing the community of their risk to hazards does not have to involve scare tactics; rather, ask citizens if they are aware of the various hazards that have impacted the community in the past. Ask them what they think the local government should be doing to mitigate the risk. Strive to make the information personally relevant; ask them if hazard mitigation is important to them. Share examples of how the community is currently addressing hazards, including statistics wherever possible (such as number of properties acquired in the floodplain, or number of homes evacuated during a wildfire). Encourage them to join existing local mitigation initiatives, such as the Firewise Communities Program. Most importantly, start identifying local champions that can advocate on the community's behalf. Building support for hazard mitigation efforts is much easier with the public on your side.

Overview of Planning Tools and Strategies

The planning tools and strategies highlighted in this guide represent those commonly used in Colorado communities to address hazard mitigation, as well as some newer strategies. The tools are divided into the following seven categories:

- Addressing Hazards in Plans and Policies
- Strengthening Incentives
- Protecting Sensitive Areas
- Improving Site Development Standards
- Improving Buildings and Infrastructure
- Enhancing Administration and Procedures

Each tool profile includes the following components:

- **Hazards Addressed by the Applicable Tool.** Individual tools include icons indicating the applicable hazards. (Keep in mind that tools may be applicable to multiple hazards.)
- **How it Works.** Description of the tool including relevant background information, how it works, and examples for how it is used to reduce risk to hazards.
- **Implementation.** Description of how a community would implement the tool. For example, does a tool require adoption of an ordinance, or a special study?
- **Where it's Been Done.** This section provides examples of Colorado communities that are using the particular tool, highlighting any lessons learned or other specifics.
- **Advantages and Key Talking Points.** A list of the primary benefits associated with the particular tool, as well as suggestions for communicating those benefits to stakeholders.
- **Challenges.** A list of the frequent challenges associated with the particular tool.
- **Key Facts.** The basic requirements and notable facts related to the tool, including:

Administrative capacity
Mapping requirements
Regulatory requirements
Maintenance requirements
Adoption requirements
Applicable statutory requirements
Associated costs

- **Model Code Language and Commentary.** For some tools, model language is included to illustrate actual regulatory language that could help implement the tool, along with commentary. While users of the guide are welcome to use the example language, the model codes should be viewed as a starting point. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.
- **Additional Information.** For some of the tools profiled, there are publications or sites where the reader can learn more about the tool. Includes examples where communities have used this tool and contact information where the reader can obtain additional information.

Although the focus of many of the concepts and tools highlighted in this chapter relate to planning, the land use planner will not always take the lead role. For example, changes to building codes will be led by the building official, and may require review by the local planner, emergency manager, and local fire authority. Implementing these planning tools and strategies requires thoughtful coordination with other departments and external stakeholders.

The table on the following pages summarizes the planning tools applicable to each hazard.

SUMMARY OF PLANNING TOOLS AND STRATEGIES	 Avalanche	 Drought	 Earthquake
ADDRESSING HAZARDS IN PLANS AND POLICIES			
Comprehensive Plan	✓	✓	✓
Climate Plan	✓	✓	
Community Wildfire Protection Plan (CWPP)			
Hazard Mitigation Plan	✓	✓	✓
Parks and Open Space Plan	✓	✓	
Pre-Disaster Planning	✓	✓	✓
STRENGTHENING INCENTIVES			
Community Rating System			
Density Bonus	✓		
Development Agreement	✓		
Transfer of Development Rights	✓		
PROTECTING SENSITIVE AREAS			
1041 Regulations	✓	✓	✓
Cluster Subdivision	✓		
Conservation Easement	✓		
Land Acquisition	✓		
Overlay Zoning	✓		
Stream Buffers and Setbacks			
IMPROVING SITE DEVELOPMENT STANDARDS			
Stormwater Ordinance		✓	
Site-Specific Assessment	✓		
Subdivision and Site Design Standards	✓	✓	
Use-Specific Standards	✓		
IMPROVING BUILDINGS AND INFRASTRUCTURE			
Building Code	✓	✓	✓
Critical Infrastructure Protection	✓		✓
Wildland-Urban Interface (WUI) Code			
ENHANCING ADMINISTRATION AND PROCEDURES			
Application Submittal Requirements	✓		
Post-Disaster Building Moratorium			✓

Flood	Hazardous Material Release	Extreme Heat	Landslide, Mud/ Debris Flow, and Rockfall	Soil Hazards	Wildfire	Wind Hazards	Severe Winter Storm
✓	✓	✓	✓	✓	✓	✓	✓
✓		✓	✓		✓	✓	✓
					✓		
✓	✓	✓	✓	✓	✓	✓	✓
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Addressing Hazards in Plans and Policies

There are numerous opportunities to effectively integrate and address the mitigation of known hazards in local plans and policies.

The comprehensive plan is a community's most important and potentially effective tool for consolidating and articulating various policies that relate to planning, land use, and development. Hazard-related issues arise in a range of planning contexts, and there are different approaches for integrating hazards into comprehensive plans, discussed below. Beyond the comprehensive plan, the Local Hazard Mitigation Plan is an obvious and important place to address local hazard policy.

In addition, communities should utilize other supporting plans, policies, and programs to demonstrate clear linkages and potential synergies between hazard risk reduction and other important community goals. Each supporting plan typically should include a background study or assessment of existing and future conditions, as well as goals, strategies, and policies that can contribute to the implementation of multi-objective solutions.

Safe Growth Audits – An Effective Tool for Planners and Hazard Practitioners

As first shared by the American Planning Association's "Practice Safe Growth Audits" publication, the purpose of a safe growth audit is to "analyze the impacts of current policies, ordinances, and plans on community safety from hazard risks due to growth." The audit enables a community to evaluate the positive and negative effects of its guidance on existing and future growth on hazard vulnerability by reviewing the comprehensive plan, zoning ordinance, subdivision regulations, capital improvement plan/program, and infrastructure policies. In many ways, a safe growth audit provides a "checks and balances" approach for communities that are interested in future development but not at the expense of public safety or vulnerability to hazards.

For example, a safe growth audit asks questions such as:

- *Does the future land-use map clearly identify natural hazard areas?*
- *Are transportation policies used to guide growth to safe locations?*
- *Do environmental policies provide incentives to development that is located outside of protective ecosystems?*
- *Are the goals and policies of the comprehensive plan related to those of the FEMA Local Hazard Mitigation Plan?*
- *Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?*
- *Do subdivision regulations allow density transfers where hazard areas exist?*
- *Does the capital improvement plan/program provide funding for hazard mitigation projects identified in the FEMA Mitigation Plan?*

These and similar questions can naturally be tailored when looking at a specific hazard. As a holistic approach, however, the safe growth audit provides a comprehensive yet succinct look at a community's future based on a critique of existing plans, policies, and tools that direct new development. It also equips practitioners with the ability to zero in on the most relevant questions, gaps, or conflicts related to planning strategies that may warrant further consideration.

Additional Resources:

- *American Planning Association's Practice Safe Growth Audits (Zoning Practice Issue Number 10, 2009): planning.org/zoningpractice/open/pdf/oct09.pdf*
- *Safe Growth Audit Worksheet (excerpt from FEMA Local Mitigation Planning Handbook, 2013): mitigationguide.org/wp-content/uploads/2013/05/Worksheet-4.2.pdf*
- *American Planning Association. Hazard Mitigation: Integrating Best Practices into Planning, pp. 54-58 ("Testing Implementation with a Safe Growth Audit"). Planning Advisory Service Report 560. May 2010. fema.gov/media-library/assets/documents/19261*

Tools and Strategies

Several examples of supporting plans are discussed below, including community wildfire protection plans, climate plans, and parks and open space plans. Beyond this guidebook, other important supporting plans and programs deal with issues such as transportation, economic development, public facilities, housing, and redevelopment. In particular, it is also important for communities to address risk and factor the cost of mitigation programs into local capital improvement plans.

This section explores tools that communities can use to integrate hazard mitigation into their long-range plans and policies. Tools profiled in this section include:

- Comprehensive Plan
- Climate Plan
- Community Wildfire Protection Plan (CWPP)

- Hazard Mitigation Plan
- Parks and Open Space Plan
- Pre-Disaster Planning
- Resiliency Planning

Interdepartmental Coordination – Getting Them Involved; Keeping Them Involved

Coordination is essential to achieving a more sustainable, resilient, and safe community. Management by silos has traditionally been the norm, and promoting integration among departments can be a challenge due to limited resources and over-burdened staff. This is particularly the case in communities that have endured recent significant hazard events.

Yet the key to a successful hazard mitigation program is having departments working in an integrated fashion, routinely sharing information and ideas and avoiding policies or actions that are in conflict with each other. The following are a few tips to achieve effective, sustainable interdepartmental coordination.

***Leadership.** Achieving and maintaining effective interdepartmental coordination first requires commitment from the elected governing body and the chief executive official. They should consider creating an interdepartmental committee to promote coordination across all local efforts. To be effective, such a committee should be chaired by someone with leadership qualities. An effective leader is able to persuade his or her superiors, peers, and subordinates to adopt a common vision and strategy for how to achieve it. From a hazards perspective, they should be able to help reconcile competing objectives between departments that want to execute recovery and mitigation projects and also future planning projects.*

***Clearly Defined Roles and Responsibilities.** Effective interdepartmental cooperation and coordination requires all parties to clearly understand their role and how their job or their office contributes to the overall vision, goals, and objectives of the committee. Before any coordination effort is initiated, it is important for leadership to describe the mission of the interdepartmental committee and how it will function as an organization.*

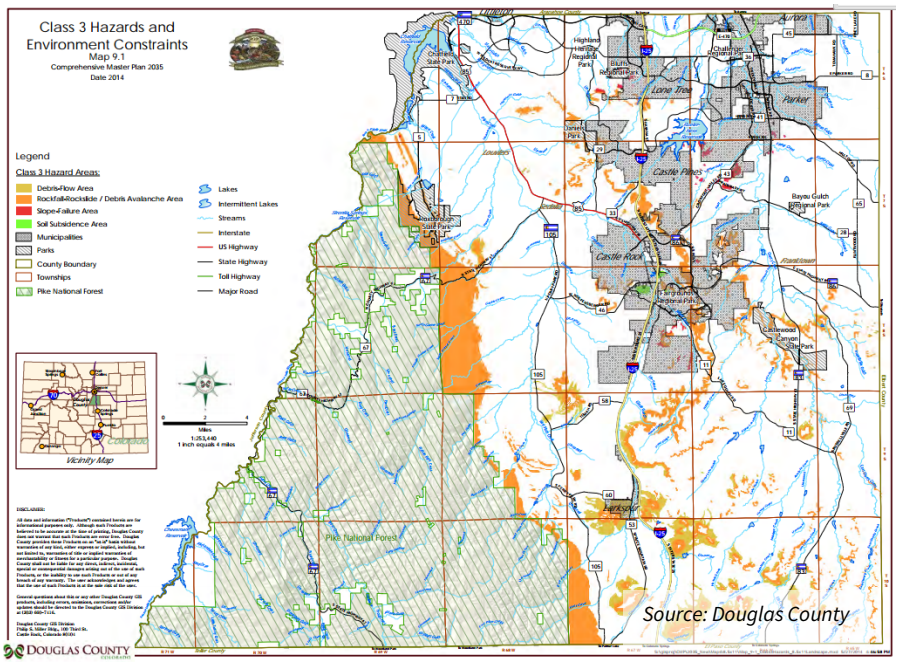
For those on the interdepartmental committee to be effective, it is important not only for the individual to understand their role, but to understand the other agencies' roles. They must be able to put themselves in another agency's shoes to understand where they are coming from and what they want to achieve.

***Effective Communication.** Open and regular communication is key to interdepartmental coordination. Effective interchange of opinions and information helps in resolving differences and in creating mutual understanding. Thus, defining protocols for both formal and informal communication between committee members and entire agencies is critical.*

***Personal Contact.** Personal or face-to-face contact is the most effective means of communication and coordination. Intragovernmental decisions are collective decisions and should reflect the engagement, coordination, and general consensus among different departments or functions in the enterprise.*

***The Heads-Up.** Finally, hold meetings only when you have something important to discuss. Prepare an agenda and distribute it to the committee members prior to the meeting so when they walk into the meeting they have a clear understanding of the purpose of the meeting.*

Comprehensive Plan



Hazards Addressed

How it Works

Integrating hazard mitigation and risk reduction into comprehensive plans is a key approach that provides an umbrella, or overarching policy framework, for various other planning tools. The comprehensive plan is a policy document, making it fundamentally different from many of the other planning tools profiled in this chapter. General considerations for integrating hazards into comprehensive plans include:

- Hazard mitigation measures are not only infrastructure-related. They can include community level communication, preparedness planning, and other non-structural measures.
- Whenever possible, mitigation measures should work to mimic natural processes rather than engineered solutions, such as reconnecting a creek to its floodplain for natural flood control rather than channelizing it.
- The safety of vulnerable communities related to natural hazard risks and other stressors should receive particular attention in the comprehensive plan.

What is a Comprehensive Plan?

A comprehensive plan (often called “master plan,” “general plan,” or “community plan”) expresses a community’s overarching vision, goals, objectives, policies, and strategies for the future growth, development, and preservation of the community, protection of community assets, and provision of services.

Colorado statutes authorize local governments to prepare master plans to serve as guiding documents. In some cases, local governments are required to prepare master plans. C.R.S. § 30-28-106(4)(a) requires counties with more than 10,000 in population and meeting defined growth percentages to adopt a master plan. Similarly, C.R.S. § 31-23-206(4)(a) requires municipalities with a population of 2,000 people or greater in a qualifying county to prepare and adopt a master plan (*House Bill 01S2-1006*, 2011).

Comprehensive plans also vary in terms of the overall organizational structure, the number and types of elements addressed, and the degree to which specific action items are threaded throughout the guiding policies. A traditional comprehensive plan is organized by element, with each element given a unique chapter or section of the plan. Common elements included in comprehensive plans include:

- Land use
- Transportation
- Housing
- Economy
- Environment
- Governance
- Parks and open space
- Recreation and tourism (only required element per state statutes)
- Community design and character

Within each of these elements, most comprehensive plans contain the following components, or some variation:

- **Vision**. What is the community's underlying vision for the future?
- **Goals**. Within each element, what are the goals the community seeks to achieve?
- **Policies**. Within each goal, how can the community address the issue to achieve desired results?
- **Strategies or actions**. What are the specific steps a community can take to address a stated issue?
- **Mapping**. What are the desired future land use scenarios, and how do existing and future conditions change based on the other elements addressed in the plan?

As planners increasingly focus on the interrelatedness of plan elements, organizing the comprehensive plan by themes is more common. For example, a community may opt to include a sustainability section within each plan element, rather than dedicating a single element to sustainability. Fort Collins' recent plan update called "City Plan" has a unique organizational framework. The plan illustrates the interconnectedness of each of the other plan elements, explores the "triple bottom line" of sustainability throughout, and is tied to the city's "budgeting for outcomes" process.

Approaches for Integrating Hazards into Comprehensive Plans

Communities increasingly address sustainability, energy, climate, and resilience in their comprehensive plans. Home rule communities have broad authority to address these and many other subjects in their plans and regulations. Statutory communities also have authority to address hazard areas in master plans. Specifically, C.R.S. § 30-28-106 (for counties) and § 31-23-206 (for municipalities) requires planning commissions to consider "the areas containing steep slopes, geological hazards, endangered or threatened species, wetlands, floodplains, floodways, and flood risk zones, highly erodible land or unstable soils, and wildfire hazards" (*House Bill 12-1317*, 2012). Because the comprehensive planning process typically involves a robust public engagement component, it is an excellent opportunity to educate the community on the importance of planning for hazards.

Both the American Planning Association and FEMA have provided helpful guidance for integrating hazard issues into the comprehensive planning process; the respective resources are cited at the conclusion of this section.

There are several approaches to addressing hazard elements in a comprehensive plan, as discussed in the subsections below.

Include a Dedicated Hazard Mitigation Element

One effective way to focus attention on the importance of hazard mitigation and avoidance in a comprehensive plan is to give the subject its own dedicated section, either as a stand-alone plan element or a subsection of another element (such as land use or environmental protection). Most Colorado communities to date have addressed hazard mitigation as a sub-section of the land use element, though this is changing as communities like Manitou Springs are exploring new plan organizations that give increased prominence to hazard mitigation.

The hazards element should include a description of known hazards to the community. For example, "the community's primary natural hazard threats are from floods, wildfires, and

Hazard Mitigation: Integrating Best Practices into Planning
American Planning Association – Planning Advisory Service (PAS) Report 560

This report was the result of lengthy dialogue with APA and FEMA about the increased awareness of the linkages between planning and hazard mitigation principles. The primary author, James C. Schwab, AICP, walks through the various approaches to incorporate hazard mitigation into planning and policy mechanisms, provides background on the planner's role in hazard mitigation, and discusses how to integrate hazards into several planning implementation tools. This valuable resource guide also explores several case studies throughout the country that are illustrative of the report's recommendations.

Chapter 3 of the report is dedicated to integrating hazard mitigation throughout the comprehensive plan. In that chapter, Schwab articulates the importance of not only including a hazard element in the plan, but to identify throughout other elements how hazards are interrelated. The report makes recommendations for integrating hazard mitigation into the specific elements, including: future land use, conservation, public facilities and services, transportation, capital improvements, housing, historic preservation, economic development, recreation and open space, environment/natural resources, and implementation.

PAS 560 can be accessed here: fema.gov/media-library/assets/documents/19261

hazardous materials transport." These statements can be supported by maps of hazard areas and more detailed descriptions of the risk.

Following the description of the hazards and risk, the hazards element should identify a hierarchy of goals, policies, strategies, and actions tailored to the specific hazard risks in the jurisdiction. While these will vary by community, a range of sample language is included below representing common approaches seen throughout Colorado.

- **Example Goals**

Reduce the impacts from [insert hazards] on [insert community] residents.
Reduce the risk of natural hazards on people, property, and the environment.
Increase public awareness of hazard risks.

- **Example Policies**

Limit building in high-risk areas.
Direct future growth to low-risk areas.
Improve public education and awareness campaigns as well as proactive warnings for natural hazards.
Review and designate appropriate uses and intensities of land uses within known hazard areas.
Improve mapping of hazard risk.
Planning staff should coordinate regularly with emergency management staff to identify cross-beneficial projects and avoid any potentially conflicting goals or strategies.

- **Example Strategies and Actions**

Expand mapping, regulations, and loss-prevention for areas with high risk to hazards.
Update subdivision regulations to include criteria for potential hazard areas.
Identify data needs to effectively identify high-risk areas and better manage development and activities within the community.
Update zoning code to reflect appropriate land uses and intensities within known hazard areas.
Update development application submittal requirements to address hazard-related technical reports and mapping analysis.
Prevent development on geologically unstable areas or steep slopes.
Update subdivision regulations to require defensible space when developing near the wildland-urban interface.
Adopt a local wetland ordinance that provides an appropriate buffer distance from water bodies.
Revise development regulations to prevent development on slopes greater than 30 percent.
Revise development regulations to require adequate mitigation prior to approval of development applications.
Require new development to be within a fire district with adequate fire protection facilities, equipment, and service capabilities.

Discourage development within areas of high potential for heaving bedrock, as identified on the steeply dipping/heaving bedrock map.
Require engineering designs for improvements to roads and utilities to address mitigation of geologic hazards during the subdivision review process.

Adams County is an example of a community that incorporated a specific hazard mitigation section in its comprehensive plan, *Imagine Adams County* (2012). In that section, the county identifies three primary policies:

- Reduce risk and effects of natural and industrial hazards;
- Increase public awareness of hazard risks; and
- Limit building in high-risk areas and improve disaster prevention.

The county also integrated their Hazard Identification and Risk Assessment (HIRA) into the plan, as an appendix. That HIRA includes an in-depth analysis of land uses and their relation to hazards. With a particular focus on hazardous materials, the HIRA appendix compares future land use designations to the number of hazardous materials facilities (*Imagine Adams County*, 2012).

Address Hazard Mitigation throughout the Plan

Often, however, hazard mitigation is not given individual emphasis in a comprehensive plan, but is integrated throughout the plan elements. If a separate hazards element is not included in the plan, the model goals, policies, and strategies from the previous section could be tailored to support other plan elements. Sample considerations and questions to ask for various plan elements are provided below, based in part on issues noted in the FEMA and APA references cited at the conclusion of this section.

- **Land Use.** Establish land-use policies that discourage development or redevelopment within natural hazard areas. Provide adequate space for expected future growth in areas located outside natural hazard areas. Ensure that safety is explicitly included in the plan's growth and development policies.
- **Transportation.** Provide adequate primary, secondary, and emergency connections within and between subdivisions. Ensure road layouts and connections support response requirements for emergency services. Consider whether transportation policy is used to guide growth to safe locations.
- **Conservation/Resource Protection.** Identify areas that are community and natural assets and also that, when protected or restricted to development, would reduce risk to natural hazards. For example, avoiding development in forested areas provides a tangible resource to the community while also reducing exposure of people and structures to wildfires.
- **Economic Development.** Communicate the short- and long-term economic benefits of planning for hazards and developing resilient communities (e.g., lower long-term infrastructure repair costs). Evaluate whether economic development policies promote commercial or industrial expansion in areas vulnerable to hazards. Make

community resilience a key feature in attracting, expanding, and retaining businesses and industry.

- **Public Facilities.** Identify appropriate locations for all public facilities, but especially critical facilities whose continued operation is essential during or following a major hazard event. For example, police and fire stations, water treatment plants, and community centers are important facilities that should not be located in hazardous areas.
- **Housing.** Ensuring that the location and design of new or improved housing complies not only with existing building codes, but with potential hazards in mind. Identify opportunities to strengthen or replace structures identified as vulnerable to hazards. Consider whether a disproportionate amount of affordable housing is located within known hazard areas. Address the challenges communities face in locating dense residential areas away from hazards. One particular challenge to consider is that some of the most desirable places to live can often be within hazard areas (forests, oceans, slopes, and rivers).
- **Recreation and Tourism.** Areas that serve as recreation opportunities (such as trails and bike paths) can also serve hazard mitigation purposes by limiting development. This element could also include recommendations for land acquisition. Recreation and tourism, especially as it relates to hazard mitigation, can also be addressed in parks and open space or natural resources elements depending on the plan organization.

Douglas County is an example of a community that has taken this approach. The *Douglas County 2035 Comprehensive Master Plan* (2014) addresses geologic hazards, flooding, and wildfire. There are a series of goals and policies related to hazards in the environmental quality sections, and additional relevant policies scattered throughout the plan. For example, wildfire is addressed in the urban land use section of the plan, the non-urban section of the plan, and in the environmental quality section of the plan (where an entire subsection is dedicated to wildfire) (*Douglas County 2035 Comprehensive Master Plan*, 2014). As with Adams County, the hazard components of the plan are accompanied by a map, providing additional justification for future land use decisions.

Based on current research, more Colorado communities emphasize hazard mitigation as a discrete section in their comprehensive plans than choose to weave hazard mitigation through various plan elements. However, new plans are always underway. As of August 2015, the City of Longmont and the Town of Milliken were both in the process of developing comprehensive plans with a resilience component. The City of Manitou Springs is embarking on an integrated planning process for a hazard mitigation plan and a comprehensive plan that will weave hazard-related issues into all plan elements. Users of this guide should check back with those communities to review the method in which hazards are addressed in those plans.

Identify Hazards on the Future Land Use Map

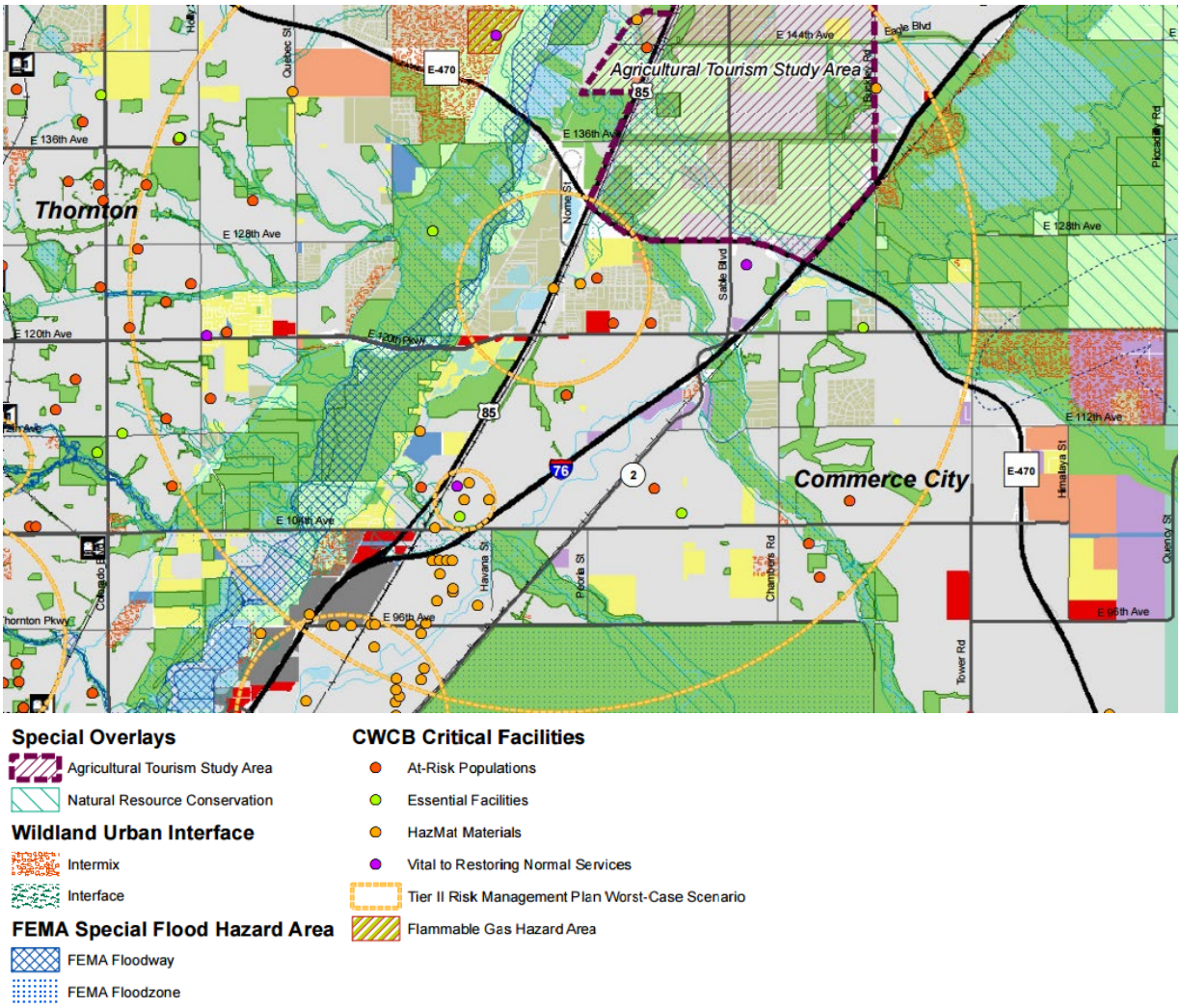
The future land use map illustrates how the community intends to grow over time. It identifies appropriate areas for growth and development, often accompanied by supporting details such as types of land uses and appropriate densities. Future land use maps can be helpful tools to guide community officials when making decisions about development proposals. A clear future land use map can also set the stage for regulatory changes that support the stated policies of the comprehensive plan. Showing known hazard areas on the future land use map provides maximum transparency to a community's citizens and decision-makers.

Future land use maps are typically either **parcel-specific** or **character-based**. Parcel-specific land use maps show the desirable types of land uses for specific detailed sites. These can be helpful for making future zoning and planning decisions, but they require upfront evaluation of specific areas that may not be possible as part of a broad, community-wide planning process. Character-based maps show conceptually which general areas, nodes, or corridors within a community are appropriate for various types of uses. They are less detailed than parcel-specific maps in describing specific uses and parcels; that allows for more flexibility to evaluate specific development proposals, but also provides less predictability.

It is important to ensure that future development patterns are consistent with known hazard areas. For example, areas marked for "higher density residential development" should not overlap with floodplains, the wildland-urban interface, or areas with steep slopes. The future land use map can work in concert with an adopted hazard mitigation plan to ensure that the map promotes safe growth and reconciles any conflicts between development strategies and mitigation strategies.

However, including hazard areas on a future land use map can be challenging, both technically and practically. There are multiple variables and criteria typically reviewed to determine land development suitability. The goal usually is not to restrict all development opportunity in hazard areas, but rather to use the best available data to determine the severity of the risk, mitigation requirements for development, and appropriate use of land within or near different hazard areas.

Adams County is an example of a community that has prepared a future land use map that explicitly addresses hazard risks. The Imagine Adams County Plan future land use overlays floodplains, the wildland-urban interface, and flammable gas hazard areas with future land use. An excerpt of the map is below:



A portion of the Adams County future land use map in their 2012 Comprehensive Plan includes floodplains, wildland-urban interface, and other resource protection areas. The map also shows critical facilities.

Source: Imagine Adams County (2012)

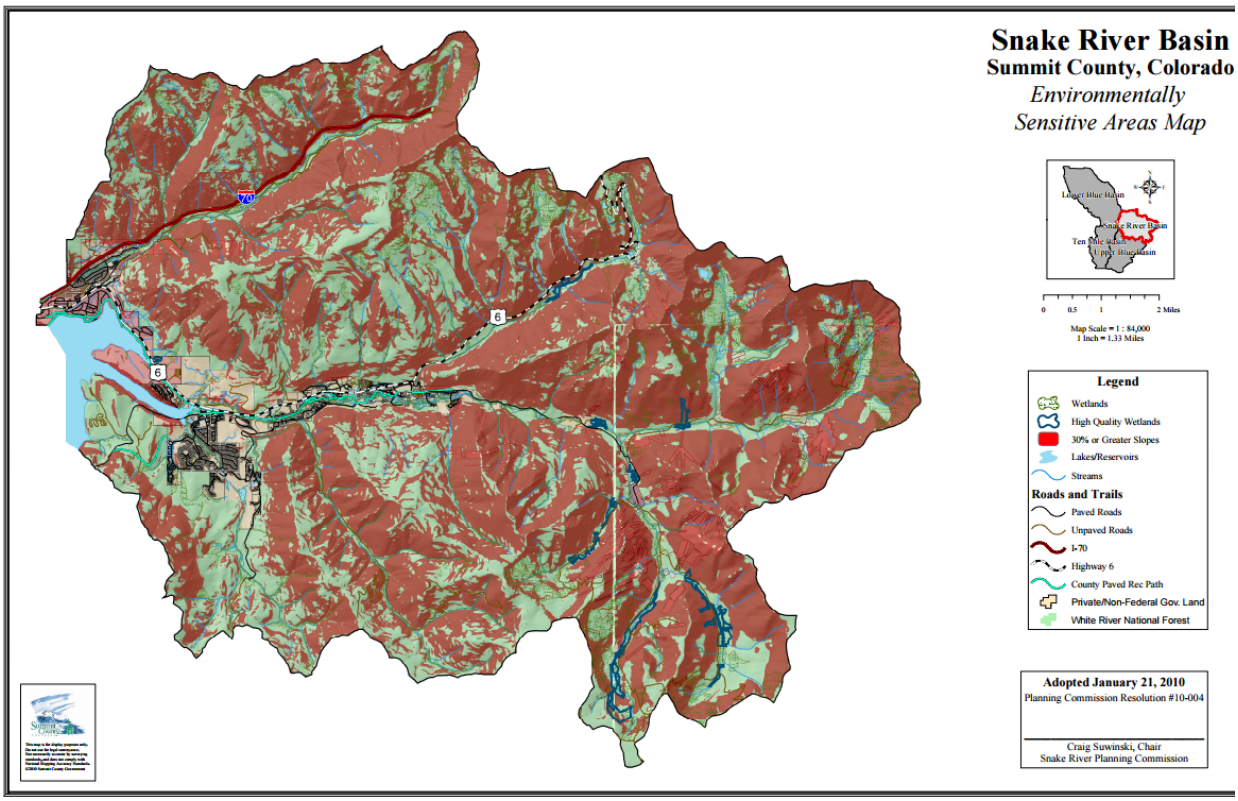
Address Hazards in Subarea Plans

Many communities prepare area-specific plans as a supplement to their jurisdiction-wide comprehensive plans. These subarea plans can be at various scales and are prepared for a variety of reasons. For example, a neighborhood plan might address housing issues, whereas a corridor plan might address mobility and economic development. Some area plans are created with the primary purpose of protecting environmentally-sensitive areas or to ensure appropriate hazard mitigation.

One such example is the *Snake River Master Plan* in **Summit County**. Adopted in 2010, the plan addresses flooding, avalanche hazards, steep slopes and other geologic hazards, wildfire, and hazardous materials transport in various sections. Even the affordable workforce housing element addresses wildfire hazard by stating that “development [in

Keystone Gulch] should occur in a manner that to the extent reasonable: mitigates wildfire hazard…" (p. 36).

Appendix C in the *Snake River Master Plan* includes architectural and environmental design standards for the basin. The first goal in that appendix includes a policy that development shall generally seek to avoid slopes over 30 percent and 100-year floodplains. Maps that accompany the Snake River Master Plan also identify hazardous areas. The map below illustrates environmentally sensitive areas in the Snake River Basin, including 30 percent or greater slopes (shaded in red).



The Snake River Master Plan includes this map showing environmentally sensitive areas in the basin. Slopes greater than 30 percent are shaded in red on this map.

Source: Snake River Master Plan (2010)

Several other examples of subarea plans addressing hazards exist in Colorado, including in Pitkin and El Paso Counties, and the Town of Gypsum.

Link the Comprehensive Plan and Local Hazard Mitigation Plan

Another way to effectively integrate hazard mitigation into the comprehensive plan is to incorporate language directly from the local hazard mitigation plan, if one exists. This means incorporating information from the HIRA, such as the description of hazards that could impact the community, identifying specific geographic areas with higher risk, and discussing how vulnerable populations should be addressed. Communities can also incorporate specific

mitigation actions from the local hazard mitigation plan by aligning them with related plan policies and actions.

The comprehensive planning process should include subject matter experts that can help strengthen the plan as it relates to hazard mitigation. Conversely, the local hazard mitigation planning process should include land use planners that can evaluate and develop feasible mitigation solutions as they relate to land use planning.

Attach the Hazard Identification and Risk Assessment (HIRA) to the Comprehensive Plan

Another approach to ensure direct coordination between the local hazard mitigation plan and the comprehensive plan is to directly attach the HIRA portion of the hazard mitigation plan to the comprehensive plan as an appendix. This ensures that both documents are aligned and elevates the importance of hazard mitigation in the community's overall planning policy document.

However, there are some unique challenges associated with this approach:

- The local hazard mitigation plan is on a five-year time horizon, so updates are typically done at regular intervals. The comprehensive plan may have shorter or longer timeframes, so the hazard identification and risk assessment may have to be adopted as a separate amendment to the comprehensive plan upon FEMA approval of the updated local hazard mitigation plan.
- The hazard identification and risk assessment can be lengthy. It is common for the HIRA to exceed 200 pages. A comprehensive plan is typically a much shorter document, often under 100 pages total.

Cross-Reference Other Hazard Plans in the Comprehensive Plan

Incorporating the HIRA or other hazard plans through cross references allows such documents to be identified in key sections of the plan but avoids overwhelming the comprehensive plan with the entirety of hazards information.

For example, the **Glenwood Springs** Comprehensive Plan, adopted in 2011, includes several linkages to relevant hazard mitigation information in the appendices. For example, Appendix 7, Public Utilities and Services, describes the city's Community Wildfire Prevention Plan and also discusses the hillside overlay protection ordinance as a relevant hazard mitigation tool for the city.

Advantages and Key Talking Points

Because the comprehensive plan serves as the overarching policy guidance document for the community, there are several advantages for developing a plan that integrates hazard mitigation:

- The planning process typically involves a large audience, including the general citizenry, interdepartmental staff, and other stakeholders from the community, allowing for increased public outreach and engagement on hazards.
- The process typically looks at future land uses to determine what is best for the community.
- Compliance with the comprehensive plan is often tied to approval criteria for development applications.
- Allows for integration of other policy documents that address hazards into one unified location.

Challenges

The comprehensive planning process is an all-encompassing document; therefore, communities have to strike a balance between including policies related to every topic, and maintaining a user-friendly and concise document. This means that the comprehensive plan may not always be the only place to look for policy direction on any one given issue. In the case of hazard mitigation, the comprehensive plan must be used in concert with the Local Hazard Mitigation Plan (if such plan exists). Other challenges include:

- Developing a comprehensive plan, or comprehensive plan update, can be time intensive.
- Comprehensive plans must be updated periodically to match shifts in policy direction related to specific elements.

Key Facts

Administrative capacity	Planner lead, with support from other departments such as public works, parks, engineering, finance, and others
Mapping	Some technical mapping and GIS analysis may be required for integrating hazard areas into the future land use map
Regulatory requirements	None required, but can support plan implementation
Maintenance	Should be updated at a regular time interval, or sooner if conditions in the community warrant a change; if a hazard mitigation plan is submitted for FEMA approval, five-year updates are required
Adoption required	Yes, typically adopted by the planning commission, and ratified by the elected body
Statutory reference	C.R.S. § 30-28-106 (counties) C.R.S. § 31-23-206 (municipalities)
Associated costs	Staff time, plus potential costs for mapping or other technical work, public outreach activities, and consultant services

Examples

Adams County Comprehensive Plan	http://www.adcogov.org/documents/2012-comprehensive-plan
Town of Bennett Comprehensive Plan	plan-tools.com/PDFs/20111020-Bennett-Plan-Doc.pdf
Town of Crested Butte Community Plan	http://www.crestedbutte-co.gov/vertical/Sites/%7B6058FFBB-CB06-4864-B42F-B476F794BE07%7D/uploads/AreaPlan2011-full_-_small.pdf
Douglas County Comprehensive Master Plan 2035	douglas.co.us/documents/full-cmp.pdf
Glenwood Springs Comprehensive Plan	http://gwsco.gov/DocumentCenter/View/133/2011-Glenwood-Springs-Comprehensive-Plan-PDF?bidId=
Logan County Master Plan	colorado.gov/pacific/sites/default/files/Master%20Plan%202011.pdf
City of Steamboat Springs Area Community Plan	http://steamboatsprings.net/DocumentCenter/View/1797/Steamboat-Springs-Area-Community-Plan?bidId=

For More Information

American Planning Association: Hazard Mitigation: Integrating Best Practices into Planning (PAS 560)
fema.gov/media-library/assets/documents/19261

FEMA: Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials (March 2013)

fema.gov/media-library-data/20130726-1908-25045-0016/integrating_hazmit.pdf

Climate Plan

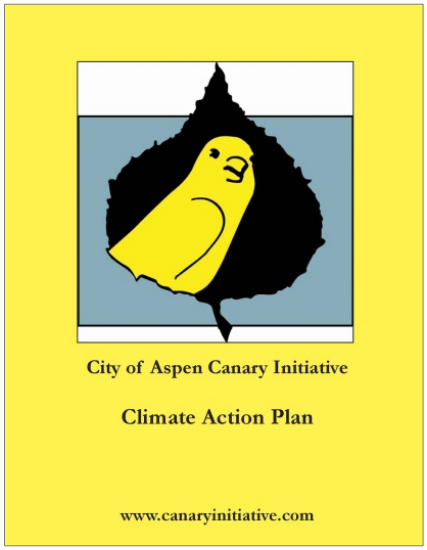
Source: Clarion Associates

Hazards Addressed

How it Works

Climate plans, also referred to as "climate action plans," are an increasingly common type of specialized plan developed by local governments to address the challenges of a changing climate. They are designed to provide a strategic framework for driving local actions to assess, understand, and reduce greenhouse gas emissions, identified as a root cause of climate change. Plans increasingly also include strategies to prevent or minimize the anticipated adverse effects of climate change.

One distinction in climate planning terminology is important: "mitigation" refers to the practice of reducing greenhouse gases, while "adaptation" refers to anticipating and taking action to reduce the adverse consequences of climate change, including those relating to natural hazards risks. An example of a mitigation strategy might be converting public buses to biodiesel or other alternative fuels, while an example of an adaptation strategy would be adopting a larger setback from flood-prone areas.



The City of Aspen adopted its Climate Action Plan in 2007, one of the earliest plans adopted in the state, as part of the Canary Initiative, a community effort to reduce the threat of climate change. It has been recently updated for 2018-2020.

Source:
aspenpitkin.com/Portals/0/docs/City/GreenInitiatives/Canary/CAP-final%20without%20dates.pdf

At a minimum, climate plans include:

- An inventory of existing emissions;
- The identification of reduction goals or targets; and
- The evaluation and prioritization of local actions to achieve those emission goals or targets.

Ideally, they also include:

- An assessment of current and projected climatic conditions (based on data that is downscaled for local applicability);
- A strategy for preparing and adapting to the negative effects or consequences; and
- The identification of resources or funding sources required to implement the overall plan.

While local climate plans largely serve as a blueprint for emission reduction efforts, many communities find it advantageous to address climate preparedness and adaptation efforts in the same document. In these cases **the development and implementation of the climate plan should be integrated with the local hazard mitigation plan** to eliminate duplication of effort but also to ensure that the assessment and understanding of climate-related vulnerabilities and community risk reduction strategies are consistent and closely coordinated. Community goals and policies for climate change mitigation and adaptation should also be incorporated into the local comprehensive plan, as many strategies will likely overlap with policies across multiple elements. Colorado communities should be prepared for an increased threat from natural hazards such as drought, extreme heat, wildfire, or severe storms based on climate change projections.

Implementation

Similar to many other plans, the long-term effectiveness of climate plans requires the local adoption and execution of policies, actions, and programs identified in the plan, as well as measuring their success over time. Unique to climate plans, however, is the need to quantify, measure, and report progress on the reduction of greenhouse gases over a given time period as prescribed in the plan. Therefore, communities must be prepared to develop and maintain a greenhouse gas inventory or identify a source for this scientific data (such as the Colorado Climate Center, cited below).

Climate action plans also typically differentiate between community-wide actions and those assigned to specific local agencies or departments, each of which should be held accountable for managing certain sources of emissions. The implementation of climate plans also relies heavily on the completion of specific actions designed to mitigate or adapt to the effects of climate change. For purposes of natural hazard mitigation, this requires the routine tracking, evaluation, and reporting of risk reduction strategies that may also be referred to separately as climate adaptation or climate preparedness actions. Effective intergovernmental coordination on these parallel or overlapping efforts is paramount for success.

Where It's Been Done

Plaza near Union Station, Denver, CO.

Source: Arina P. Habich

In 2018, the **City of Denver** published the *80x50 Climate Action Plan*, which calls for deep decarbonization of buildings, transportation, and electricity generation. Reducing carbon emissions by 80% by 2050 (80x50) refers to the commitments made by signatories to the Paris Climate Agreement in 2015, in order to limit warming to less than 2 degrees Celsius. The plan includes interim targets to:

- Reduce total community-wide greenhouse gas emissions 30 percent by 2025, a more aggressive goal than the Paris climate accords
- Make all new buildings net-zero by 2035
- Achieve 100 percent renewable electricity in municipal facilities by 2025 and community-wide by 2030
- Increase electric vehicle registrations in Denver to 30 percent by 2030.

The plan highlights key strategies in the three sectors most responsible for greenhouse gas emissions in the City: buildings, transportation and electricity generation.

In November 2015, **King County, Washington,** approved a comprehensive update to its *Strategic Climate Action Plan* (SCAP) which serves as a national best practice for a plan that actively addresses both climate change mitigation and adaptation. The plan includes two clear and distinct sections: one focused on reducing greenhouse gas emissions and the other on preparing for climate change impacts, with the latter recognizing that many impacts are now inevitable. The SCAP effectively serves as King County's blueprint for climate action with a paramount goal to integrate mitigation and adaptation tactics into all areas of local government operations, plans, policies, and procedures – including the County's Comprehensive Plan, which began including climate resiliency recommendations in 2008.

In 2017, the **City of Boulder** released *Boulder's Climate Commitment*, a progress report on its climate actions. The report details the City's mitigation and adaptation efforts, including its commitment to use 100% renewable energy by 2030. The strategic framework laid out in the Climate Commitment guides the city's climate work in three action areas: energy, ecosystems, and resources.

The **City of Aspen** updated their *Climate Action Plan* in 2017, originally adopted in 2007, with renewed actions and goals for achieving a low-carbon city. Two documents were produced by the climate planning process: the *Greenhouse Gas Toolkit* and the *Climate Action Plan*, which draws on specific actions outlined in the Toolkit. The plan is guided by a vision to

reduce greenhouse gas emissions within the city 30% by 2020 and 80% by 2050, in line with recommendations from international climate change experts. Strategies are categorized by waste, aviation, transportation, commercial energy, and recreational energy with specific targets to reduce emissions in each sector.

Advantages and Key Talking Points

Climate plans establish the roadmap for how a community will address climate change through mitigation and adaptation activities. Climate plans can help assess and communicate how projected changes in climate may impact the community in social, economic, and environmental terms, and identify actionable and measureable strategies for minimizing those impacts. Other benefits include:

- Affirms that the community is locally engaged in the issue of global climate change.
- Describes how climate change is expected to affect future economic and environmental conditions, including natural hazards.
- Establishes clear goals and targets to evaluate progress over time.
- Includes a variety of no-cost or low-cost investment opportunities along with "no regret" policy options that elected leaders can more readily support.
- Provides an additional mechanism for implementing or advancing hazard risk reduction strategies (climate adaptation). For example, climate plans may support and/or be directly linked to actions identified in the local hazard mitigation plan, such as the replacement of aging stormwater infrastructure to better accommodate increased flows resulting from more intense rainfall events and earlier spring runoff.
- Can complement a community's hazard mitigation plan by helping to inform the risk assessment and mitigation strategy.

"No Regret" Policy Options

Due to the uncertainties associated with future climate change, many communities are seeking to identify and prioritize "no-regrets" approaches to their decision-making process. These include actions that can be easily justified from social, economic, and/or environmental perspectives based on current conditions and whether the impacts of climate change and natural hazard events actually occur or not. In other words, no-regrets actions are considered cost-effective now under a range of future scenarios and do not involve hard trade-offs with other policy or funding alternatives.

Challenges

Climate plans often require technical and scientific expertise to prepare, particularly in downscaling global or regional climate model data and developing a local baseline inventory of greenhouse gas emissions. Such expertise may not be available locally and can be expensive to obtain. Other related challenges include:

- Climate change remains a potentially divisive issue for some stakeholders, including elected officials.

- Uncertainty and wide ranges of potential future scenarios are inherent to any long-term climate model projections.
- Can be challenging to implement specific actions and achieve goals without adequate funding or resources, particularly for emissions reduction.

Key Facts

Administrative capacity	Community planner supported by experts in climate science
Mapping	Not typically required
Regulatory requirements	None required, but can support plan implementation
Maintenance	Should be updated at a regular time interval, preferably every three to five years
Adoption required	Yes
Statutory reference	N/A
Associated costs	Staff time, plus potential costs for quantifying greenhouse gas emissions, downscaling climate models or other technical work, public outreach activities, and/or consultant services

Examples

City of Aspen Climate Action Plan	https://www.cityofaspen.com/DocumentCenter/View/1893/Aspens-Climate-Action-Plan-2018-2020
City of Boulder Climate Action Plan	bouldercolorado.gov/climate
Town of Carbondale Energy and Climate Protection Plan	https://www.carbondalegov.org/document_center/Building/Energy%20and%20Climate%20Protection%20Plan.PDF
City and County of Denver Climate Action and Adaptation Plans	https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/Climate/CAP%20-%20FINAL%20WEB.pdf
City of Fort Collins Climate Action Plan Framework	https://www.fcgov.com/climateadaptation/
City of Glenwood Springs Energy and Climate Action Plan	garfieldcleanenergy.org/pdf/government/climate-plans/Glenwood-Springs-ECAP.pdf
Town of Basalt Climate Action Plan	http://basalt.net/333/Climate-Change

King County, WA Strategic Climate Action Plan	https://www.kingcounty.gov/services/environment/climate/actions-strategies/climate-strategies/strategic-climate-action-plan.aspx
State of Colorado Climate Plan and Water Plan	https://www.codot.gov/programs/environmental/Sustainability/colorado-climate-plan-2015 (Climate Plan) colorado.gov/cowaterplan (Water Plan)

For More Information

Colorado Department of Public Health and Environment Climate Change Website
colorado.gov/pacific/cdphe/categories/services-and-information/environment/air-quality/climate-change

Colorado Water Conservation Board Climate Change Website
cwcb.state.co.us/environment/climate-change/Pages/main.aspx

U.S. Department of Agriculture (USDA) Climate Hubs
https://www.climatehubs.oce.usda.gov/hubs/northern-plains

Colorado Climate Network
http://rockymountainclimate.org/index.htm

Colorado Climate Change Vulnerability Study
wwa.colorado.edu/climate/co2015vulnerability

Colorado Climate Center
http://climate.colostate.edu/

The Colorado Climate Preparedness Project
https://wwa.colorado.edu/publications/reports/WWA_ColoClimatePreparednessProject_Report_2011.pdf

Compact of Colorado Communities
https://www.compactofcoloradocommunities.org/home/

Rocky Mountain Climate Organization
rockymountainclimate.org

Community Wildfire Protection Plan (CWPP)

Source: Boulder County

Hazards Addressed

Wildfire

How it Works

Title I of the Healthy Forest Restoration Act (HFRA) of 2003 authorizes communities to draft and implement **Community Wildfire Protection Plans (CWPPs)**. Community Wildfire Protection Plans (CWPPs) are local plans that are designed to specifically address a community's unique conditions, values, and priorities related to wildfire risk reduction and resilience. Communities with CWPPs in place are given priority for funding of hazardous fuels reduction projects carried out under the HFRA.

CWPPs can vary in scope, scale, and detail, but if prepared they must meet minimum requirements for their contents and adoption in Colorado as described by HFRA and the Colorado State Forest Service (CSFS), per Colorado Senate Bill 09-001. These requirements include:

- A collaborative process including the local government, local fire authority, local CSFS representatives, representatives of relevant federal land management agencies, and other relevant non-governmental partners.
- A description of the community's wildland-urban interface (WUI) outlined on a map with an accompanying narrative.
- A community risk analysis that considers fuel hazards, risk of wildfire occurrence, and community values to be protected.
- Recommendations and an implementation plan to identify fuels treatment projects, methods to reduce structural ignitability, and project priorities.

In practice, many CWPPs go beyond these requirements by engaging additional stakeholders (e.g., non-governmental organizations, community groups, and residents) to provide input

and increase local buy-in for future projects. Many plans also include a narrative on local fire history, community demographic information that may affect the future WUI, and any linkages with other local plans.

To maximize synergy between wildfire risk reduction and community land use planning activities, CWPPs should reference comprehensive plan policies, consider and inform the future land use map as part of wildland-urban interface planning, and look for opportunities to implement wildfire risk reduction activities (e.g., defensible space) through the land development code.

Many communities also include CWPP actions to support their efforts in becoming a "fire adapted community" by participating in national wildfire mitigation programs such as Firewise: Residents Reducing Wildfire Risks (commonly referred to as "Firewise") is a national recognition program administered by the National Fire Protection Association that provides guidance and steps for homeowners and neighbors to voluntarily engage in wildfire risk reduction activities at a local scale. "Ready, Set, Go!" is a national program administered by the International Association of Fire Chiefs that provides guidance to homeowners and fire departments on wildfire preparedness, evacuation planning, and other emergency response issues associated with wildfire planning.

Further detail on plan components and guidance is available through the Colorado State Forest Service (CSFS) website: csfs.colostate.edu/wildfire-mitigation/community-wildfire-protection-plans.

Implementation

A CWPP's scale will determine the level of detail required for effective implementation. CWPPs can be developed for any type of community, such as neighborhoods, towns, fire protection districts, and counties. Information and level of specificity should match the plan's scale. For example, county-level CWPPs are excellent "umbrella" plans for guiding priorities in smaller communities or county subareas, but typically do not provide the level of detail needed for reducing risk at a site-specific scale.

CWPPs must be approved and signed by a representative from the three primary entities engaged in the development process—local government, local fire authority, and the Colorado State Forest Service. CWPPs can be adopted as a freestanding document or be attached to other plans. For example, some jurisdictions have included their CWPP as an appendix to the local hazard mitigation plan. A CWPP typically requires a major update every five years due to potential changes in the community, available data, and stakeholders. The CWPP should be regularly consulted to track project implementation and progress.

Different aspects of the CWPP process and outcomes can be seen as a best practice, including:

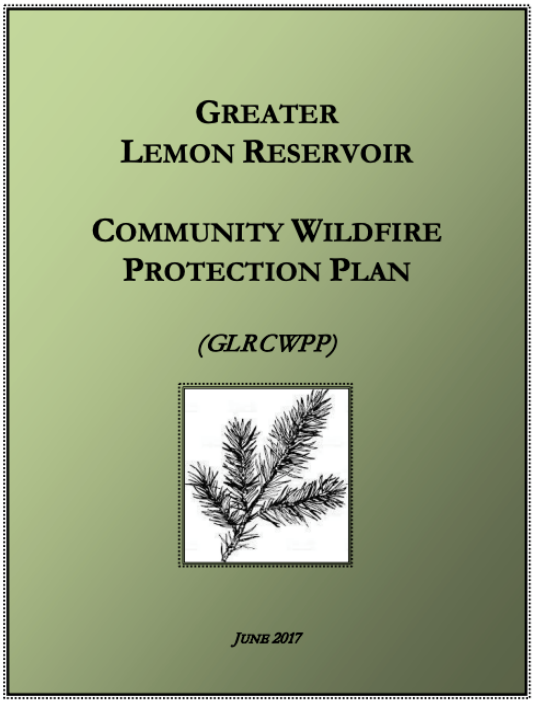
- **Collaboration.** Did the process for preparing it include genuine stakeholder engagement and public input?
- **Plan Implementation.** Does the final product reflect stakeholder input and will there be buy-in from the community? Does it capture an organized set of actions for the community to follow during implementation?

Tip:
The most successful CWPPs are those that are accessible to a wide variety of audiences, accurately reflect public and stakeholder input, provide specific actions, and can be tracked over time.

Where It's Been Done

The **Colorado State Forest Service (CSFS)** works closely with communities across the state to support them in the development of their CWPP. CSFS also maintains a database of those communities with an approved CWPP and the year it was adopted or last revised. These CWPPs are available for download and planners are encouraged to view these examples to determine which CWPPs are in place within their local jurisdiction or county: https://csfs.colostate.edu/wildfire-mitigation/community-wildfire-protection-plans/#1552502695900-c1410167-4c05

The **Loma Linda Subdivision CWPP** (2016) is an example of how a small community can plan for wildfire risk in collaboration with nearby neighbors and local, state, and federal partners. Loma Linda was created as a residential subdivision in 1977 and includes 198 lots, timbered and partially-timbered land, and open space. It is located in Archuleta County, just five miles north of Pagosa Springs, and is part of a larger area identified as wildland-urban interface (WUI). Loma Linda has been recognized as a Firewise community since 2014. To develop its CWPP, the community partnered with numerous agency and community partners like the Archuleta County Office of Emergency Management, Bureau of Land Management, and the Echo Canyon Ranch Manager. The plan identifies the protection capabilities of the community, describes the community's potential exposure to wildfire, identifies populations and property at-risk, and proposes mitigation actions.



The Greater Lemon Reservoir Community Wildfire Plan in La Plata County, Colorado was initiated by area residents and stakeholders in 2016, with the assistance of subject matter experts from Wildfire Adapted Partnership, the Colorado State Forest Service, and the U.S. Forest Service

Source: csfs.colostate.edu

The **East Canyon CWPP (Montezuma County)** (2014) is a good example of two separate communities that came together to increase the safety of their community as a whole. East Canyon includes the Elk Springs Ranch and Elk Stream Ranch neighborhoods, two gated communities that share the same entrance road. The East Canyon community experienced the Weber Fire in 2012, and includes both primary residences and vacation homes. This CWPP outlines the community characteristics and history that led to the desire for the two communities to combine into a single CWPP. The community assessment is well thought out and provides supplementary images of hazards and community risks. The CWPP also contains a "Desired Conditions and Recommendations for Action" table that identifies roles and allows the community to easily prioritize and track steps for reducing wildfire risk. Finally, the CWPP shows how CWPPs can effectively operate on a variety of scales. This plan tiers to county and regional land management plans as well as Montezuma and La Plata County CWPPs.

In 2012, the **West Region Wildfire Council (WRWC)**, which is based in Montrose and supports several western Colorado counties, began integrating wildfire risk assessments into their community-level CWPPs. WRWC assesses homes based on 11 wildfire risk elements on properties that have a primary home. Each wildfire risk element is weighted based on how much that element effects home vulnerability from a wildfire (e.g., wood roof results in higher

points than missing address signage). The end result is a community map indicating Extreme to Low wildfire risk parcels, which can then enable each CWPP to provide community and individualized risk reduction recommendations.

This information makes the CWPP implementable and accessible because homeowners can look up their risk rating by address. In addition, this information provides a tool for targeting specific audiences. For example, as part of the annual National Community Wildfire Preparedness Day, WRWC sent postcards to all "Extreme", "Very High" and "High" rated homes within one of the local fire protection districts. The postcards informed homeowners that a recent wildfire risk assessment was completed along with their corresponding rating and invited them to attend the local community preparedness event to learn more.

The 2012 Waldo Canyon Fire – Colorado Springs, Colorado

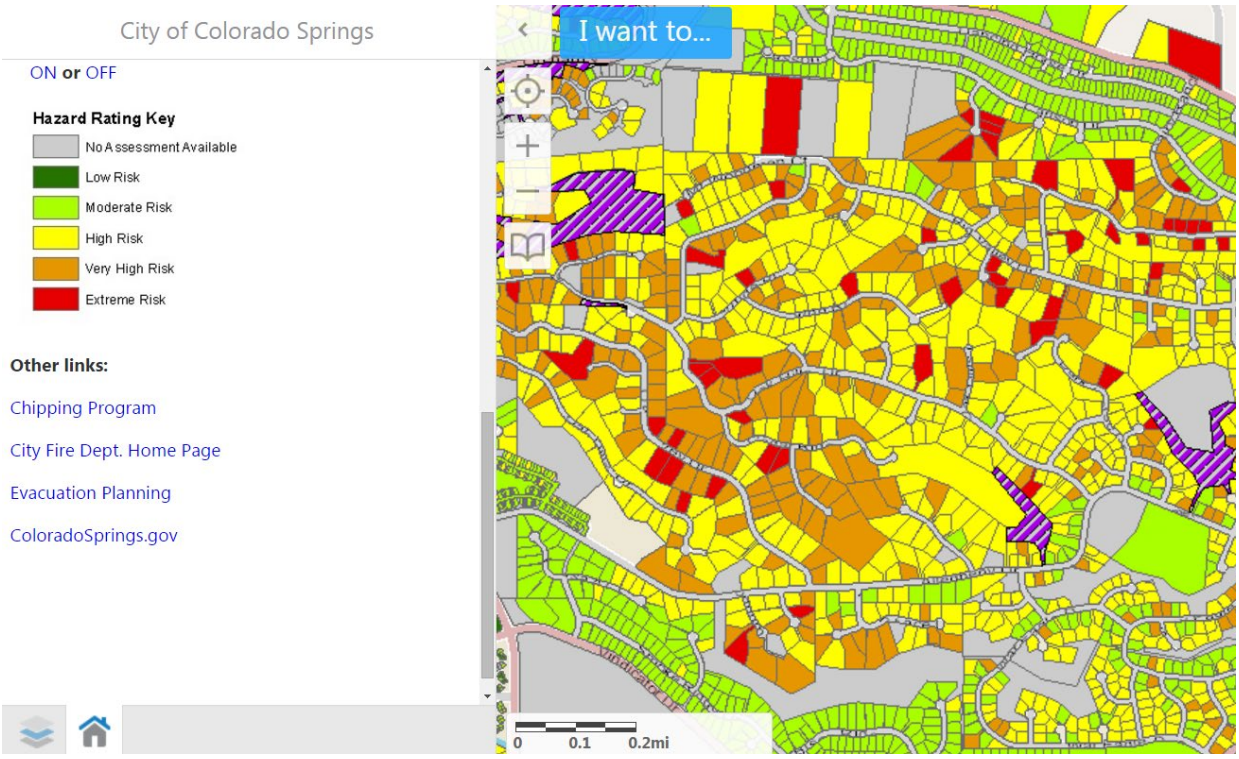
Understanding a community's wildfire risk prior to an event not only guides appropriate action but also provides valuable information during and after a wildfire. On June 23, 2012, the Waldo Canyon Fire started approximately four miles northwest of Colorado Springs, Colorado. The fire grew quickly and within days thousands of residents were evacuated. Several neighborhoods within city limits were severely affected – in total over 346 homes were destroyed. The often untold story, however, is that many positive mitigation efforts were in place prior to the wildfire event, enabling more effective wildfire response and contributing to over 80% of potentially at-risk homes being saved during the Waldo Canyon Fire.

The Colorado Springs Fire Department had been working on wildfire risk assessment and mitigation efforts for years prior to the Waldo Canyon Fire. As early as 1993, the City passed an ordinance on vegetation management, roadway width, and sprinkler installation (applicable to development occurring after April 1993), and has subsequently adopted additional ordinances to strengthen building and construction occurring in the wildland-urban interface. The City's first Wildfire Mitigation Plan was completed in 2001; meanwhile the Colorado Springs Fire Department Wildfire Mitigation Section began using the ***Wildfire Hazard Risk Assessment (WHINFOE****) tool to determine risk ratings from low to extreme. Nearly 36,000 homes in 63 neighborhoods were identified as at-risk in the wildland-urban interface. An online public mapping tool was developed to display fire hazard ratings and a risk category for each property, with additional details such as distance between structures, predominant roofing and siding material, defensible space around the structure, and vegetation density. Creating and maintaining accessible wildfire risk assessment information has proved useful in multiple ways:*

- *Homeowners were very responsive to the online website— it increased awareness and engagement.*
- *The site fosters proactive mitigation actions prior to any wildfire event occurring.*
- *The level of information available to practitioners has also facilitated greater learning after the wildfire.*

A post-fire assessment team, led by the Insurance Institute for Business and Home Safety, observed where mitigation strategies were effective during the Waldo Canyon Fire by conducting home assessment surveys. The results showed less damage to homes that had employed mitigation strategies such as reducing fuel loads, spacing structures appropriately, and including landscaping breaks to prevent spread. The pre-fire data provided invaluable information for comparative post-fire damage assessments, and enabled wildfire practitioners to glean insights on wildfire mitigation. Finally, promoting awareness and partnerships through the risk assessment process complemented the success of many other mitigation efforts, such as the development of a Community Wildfire Protection Plan, grant funding and administration, adoption of progressive code requirements for new construction, and fuel treatments.

This outreach resulted in record turnout, with homeowners signing up for follow up professional assessments and completing additional mitigation projects.



Source: Colorado Springs Fire Department. Wildfire. March 11, 2019 gis.coloradosprings.gov/Html5Viewer/?viewer=

The Colorado Springs Fire Department provides the public with an opportunity to view their wildfire hazard rating online. This information is collected for properties in the area of the city designated as the WUI

Advantages and Key Talking Points

Developing and implementing a CWPP has many advantages for a local community, including:

- Provides the opportunity to establish a locally appropriate definition and boundary for the wildland-urban interface (WUI) and enables communities to identify local priorities and actions.
- Enables access to additional state funding opportunities (for example, CWPPs are an eligibility requirement for communities pursuing funds through the Colorado Forest Restoration program).
- Can assist communities in influencing where and how federal agencies implement fuel reduction projects on federal lands and how additional federal funds may be distributed for projects on nonfederal lands.
- Reinforces existing stakeholder partnerships and establishes relationships among a wide variety of non-traditional partnerships.

Challenges

As is the case with many specialized local plans, there are also a few common challenges:

- Can become "one more plan" for stakeholders to put on their to-do list, and the burden of implementation may fall unevenly on a few individuals. To address this challenge, some communities now include their CWPP as a chapter or appendix to their local hazard mitigation plan. This ensures adoption and maintenance, and can provide additional leverage for funding support.
- Depending on the scale, scope, and level of detail, CWPPs can be time-intensive and costly to develop. Can require specialized knowledge to develop that may not exist in local agencies.
- Creating a plan does not necessarily guarantee actions will get funded, although this can be addressed more effectively when coordinated with other community plans and priorities.

Key Facts

Administrative capacity	Experienced planner; coordination with local fire authority; emergency manager
Mapping	WUI map required, which can be a substantial effort
Regulatory requirements	C.R.S. § 30-15-401.7
Maintenance	Recommended updates every five years
Adoption required	Yes for counties, optional for all others
Statutory reference	C.R.S. § 23-31-312; §30-15-401.7; §31-23-206 (municipalities)
Associated costs	Varies significantly depending on the level of detail and the technical analysis included in the document

Examples

Loma Linda Subdivision CWPP	https://csfs.colostate.edu/media/sites/22/2019/01/LL_CWPP_FINAL_3-24-17.pdf
Montezuma County East Canyon CWPP	csfs.colostate.edu/media/sites/22/2015/02/East-CanyonCWPP-0215.pdf
Lake Tahoe, CA CWPP	http://tahoe.livingwithfire.info/wp-content/uploads/2018/11/LakeTahoeBasinCommunityWildfireProtectionPlan_ReducedQuality.pdf
West Region Wildfire Council CWPPs	cowildfire.org/cwpps

For More Information

Colorado State Forest Service CWPP webpage
csfs.colostate.edu/wildfire-mitigation/community-wildfire-protection-plans

Colorado Wildfire Risk Assessment Portal (COWRAP) CSFS Webpage
https://csfs.colostate.edu/wildfire-mitigation/cowrap/

APA PAS Report: Planning in the Wildland-Urban Interface
https://www.planning.org/publications/report/9174069/

CWPPs in the American West (Ecosystem Workforce Program)
ewp.uoregon.edu/wfresilience

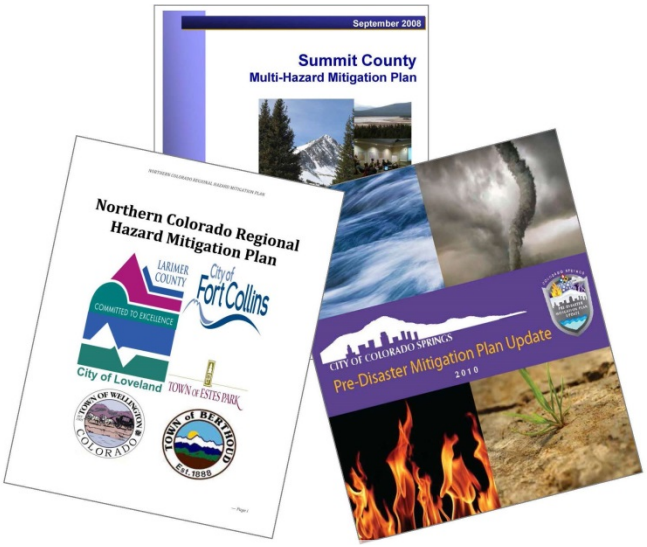
Fire Adapted Communities
fireadapted.org

Firewise Communities
https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA

Planning the Wildland-Urban Interface, American Planning Association
https://www.planning.org/publications/report/9174069/

Ready, Set, Go!
wildlandfirersg.org

Hazard Mitigation Plan



Source: Adapted by Clarion Associates

How it Works

Hazard mitigation plans are prepared and adopted by communities with the primary purpose of identifying, assessing, and reducing the long-term risk to life and property from hazard events. Effective mitigation planning can break the cycle of disaster damage, reconstruction, and repeated damage. Hazard mitigation plans can address a range of natural and human-caused hazards. They typically include four key elements: 1) a risk assessment, 2) capability assessment, 3) mitigation strategy, and 4) plan maintenance procedures. Plans can be developed for a single community or as a multi-jurisdictional plan that includes multiple communities across a county or larger multi-county planning region. While most hazard mitigation plans are prepared as stand-alone documents, they can also be developed as an integrated component of a community's local comprehensive plan. Ninety-five percent of Colorado's population resides in a community that has adopted a local hazard mitigation plan.

Local hazard mitigation planning did not become a common or standard practice for most communities until the passage of the U.S. Disaster Mitigation Act of 2000, which amended federal legislation to require the development of a hazard mitigation plan as a condition for local jurisdictions to receive certain types of non-emergency disaster assistance, including funding for mitigation projects. Today, more than 27,000 communities nationwide have adopted local hazard mitigation plans in compliance with the planning laws, regulations, and guidance promulgated by the Federal Emergency Management Agency (FEMA). To maintain

their compliance and eligibility for grant funding these plans must be updated and approved by FEMA every five years.

Similar to other local community plans, hazard mitigation plans are oriented toward anticipating and preparing for future conditions or impacts rather than responding to events as they occur. While there are various methods and practices applied in the development of hazard mitigation plans, they should all be prepared in conformance with the latest regulations and guidance from FEMA and the Colorado Division of Homeland Security & Emergency Management (DHSEM).

Perhaps even more important for local governments is the horizontal coordination and integration of hazard mitigation plans with other plans, policies, and regulations for guiding community development. Describing a process for doing so is a requirement for local hazard mitigation plans, and in recent years both FEMA and the American Planning Association (APA) have distributed specific guidance for planners on this topic (see *Additional Resources*). **When developed and implemented in concert with land use plans, zoning ordinances, or other local planning mechanisms, the local mitigation plan can be a powerful tool for reducing community vulnerability to known hazards.** Moreover, in cases where a community may not have effective plans or regulations already in place, the hazard mitigation plan can become a critical document for guiding future decision and policy making.

Implementation

Many communities have already prepared and adopted a local hazard mitigation plan, and often have done so as part of a multi-jurisdictional planning effort. Regardless, **the responsibility for plan implementation lies with each jurisdiction**. Community-specific risk assessments, actions, and procedures in support of the overall goals for the planning area must be included as part of the mitigation strategy and plan maintenance elements of the plan. While the risk and capability assessment studies help form the foundation for the plan, mitigation policies, projects, or other actions and the community's roadmap for plan implementation are found in these latter elements. The actions included in a community's mitigation strategy should address the vulnerabilities identified in the risk assessment and include a comprehensive range of mitigation measures including structural projects and non-structural activities such as development codes and regulations, public education and outreach initiatives, and natural resource protection strategies.

At a minimum, per FEMA regulations, local hazard mitigation plans must undergo a comprehensive update and be formally approved and re-adopted by the community's governing body every five years. However, to promote more effective local implementation, they should be routinely monitored, updated, and reported on by each community on a frequent basis. This is particularly critical for integrating the hazard mitigation plan into other local planning mechanisms as described above.

Where It's Been Done

Mesa County (2015) has been implementing and maintaining its hazard mitigation plan since it was first approved by FEMA in 2005. The plan was initially developed as a multi-jurisdictional plan and today covers not only all incorporated municipalities but extends to other jurisdictions including the 5-2-1 Drainage Authority and several fire protection districts. Mesa County led the plan's third comprehensive update process in 2014 under the direction of a planning committee that included representatives from all participating jurisdictions in addition to local businesses, utilities, state agencies, and other stakeholders. The County has also successfully integrated the 10-step planning process prescribed under FEMA's Community Rating System (CRS) and is among only a handful of Colorado communities to gain significant CRS credit points for floodplain management planning.

Examples of mitigation actions already completed under the direction of Mesa County's plan include the mapping of geologic and wildfire hazards, a community wildfire protection plan for the Plateau Valley, a flood mitigation project that removed more than 100 structures from the regulatory floodplain, and achieving certification as a *StormReady* community by the National Weather Service.

Tulsa, Oklahoma.

Source: Rex Brown

The plan also recognizes the importance of integrated planning, stating that "an important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other plans such as comprehensive planning, capital improvement budgeting, and regional plans. Mitigation is most successful when it is incorporated in the day to day functions and priorities of government and in land use and development planning." As such, the incorporation of information contained in the plan into other planning mechanisms remains a high priority action for all jurisdictions. Per the 2015 plan update the County has also proposed to conduct community resiliency planning through a more structured planning process.

In 2014, **Tulsa, Oklahoma,** completed a comprehensive update to its existing *Multi-Hazard Mitigation Plan* using the 10-step planning process as recommended through FEMA's Community Rating System (CRS). Although subject to many past flood disasters, today Tulsa is renowned for its status as one of the nation's most resilient and highest rated CRS communities (Class 2), thereby providing its floodplain residents with the direct benefit of a 40% discount on flood insurance costs. In order to maintain and enhance this rating, the City maintains a highly actionable and successful hazard mitigation plan that methodically addresses all natural and man-made hazards. The plan is widely recognized in as an

exemplary model for other communities to follow in their own hazard mitigation and CRS planning efforts.

Advantages and Key Talking Points

One of the most direct benefits and motivating factors for communities to prepare and adopt a hazard mitigation plan or integrate this into their comprehensive plan is maintaining their eligibility to pursue pre-disaster and post-disaster grant funding assistance for mitigation projects. Other benefits include:

- Gaining an increased awareness and understanding of local hazard risks and vulnerabilities, as well as existing mitigation capabilities and activities.
- Identifying, evaluating, and prioritizing potential risk reduction measures including both mitigation project and policy alternatives.
- Engaging and communicating with the public, community leaders, other stakeholders on the assessment and mitigation of known hazards.
- Building partnerships by involving citizens, organizations, and businesses to more comprehensively address disaster risk reduction.
- Developing strong partnerships between planners and emergency managers to fully integrate land use and hazard planning efforts.
- Aligning disaster risk reduction strategies with other community objectives.
- Communicating local risk reduction priorities to state and federal officials.
- Increasing the speed and decreasing the costs associated with disaster recovery.
- Pre-identifying risk reduction activities that can be partially or wholly funded through existing mitigation grant programs, including but not limited to FEMA's Hazard Mitigation Assistance (HMA) programs, in addition to leveraging other financial assistance to support multi-objective projects.
- Making the hazard mitigation plan a meaningful planning document rather than a requirement that simply needs to be submitted to FEMA for approval.

Challenges

The greatest challenge for most communities is the initial development of a hazard mitigation plan that meets all state and federal requirements. The planning process, which is typically managed over the course of 8-12 months, must follow a fairly prescriptive and thoroughly documented approach in order to gain final plan approval. For this and other reasons, many communities opt to participate in a multi-jurisdictional plan and/or hire an outside consultant for planning assistance. Other related challenges include:

- Sustaining momentum and keeping the plan current and relevant can be a struggle for communities, especially those without clear plan implementation and maintenance procedures and/or the resources to carry them out.
- Multi-hazard risk assessments may require various levels of technical expertise, data, and technology to accurately identify and analyze hazard threats, vulnerabilities, and potential consequences.

- Unlike many other plans, the hazard mitigation plan is not a department-specific plan but should rather include the active participation and buy-in from many local offices and community and private-sector partners that can support risk reduction efforts.
- To be effective in engaging the public and other community stakeholders in the planning process, communities have to employ a coordinated, multi-faceted approach for outreach and communications. Civic engagement in hazard mitigation planning is a challenge for many communities.
- While plan updates should not be as challenging as initial plan development, communities are expected to run through a similar planning process at least every five years to maintain compliance with state and federal requirements.

Key Facts

Administrative capacity	Experienced planner with broad intergovernmental support; emergency manager
Mapping	Mapping highly desirable for risk assessment, but is not technically required, especially for hazards for which reliable map data does not exist, or for communities that have no capacity to do their own mapping. In these cases it is still possible to do quality risk assessments and mitigation plans through other means
Regulatory requirements	None required, but can support plan implementation
Maintenance	Must be updated every five years per federal rules and state regulations (Disaster Mitigation Act of 2000)
Adoption required	Yes
Statutory reference	Code of Federal Regulations (CFR), Title 44, Chapter 1, Part 201.6; no state statutory requirements
Associated costs	Staff time, plus potential costs for mapping or other technical work, public outreach activities, and consultant services

Examples

Adams County Hazard Mitigation Plan (Integrated into Comprehensive Plan)	http://www.adcogov.org/hazard-mitigation-plan
City of Colorado Springs Pre-Disaster Mitigation Plan Update	https://coloradosprings.gov/sites/default/files/2016_hazard_mitigation_plan_lowerresolution.pdf

Mesa County Hazard Mitigation Plan	sheriff.mesacounty.us
Tulsa, OK Multi-Hazard Mitigation Plan	http://www.incog.org/Community_Economic_Development/Documents/Tulsa%20County%20hazard%20mitigation%20plan%202015%20Draft%20of%20Comments.pdf

For More Information

FEMA Multi-Hazard Mitigation Planning Website
fema.gov/multi-hazard-mitigation-planning

DHSEM's Regional and Local Hazard Mitigation Plans Website
https://www.colorado.gov/pacific/mars/mitigation

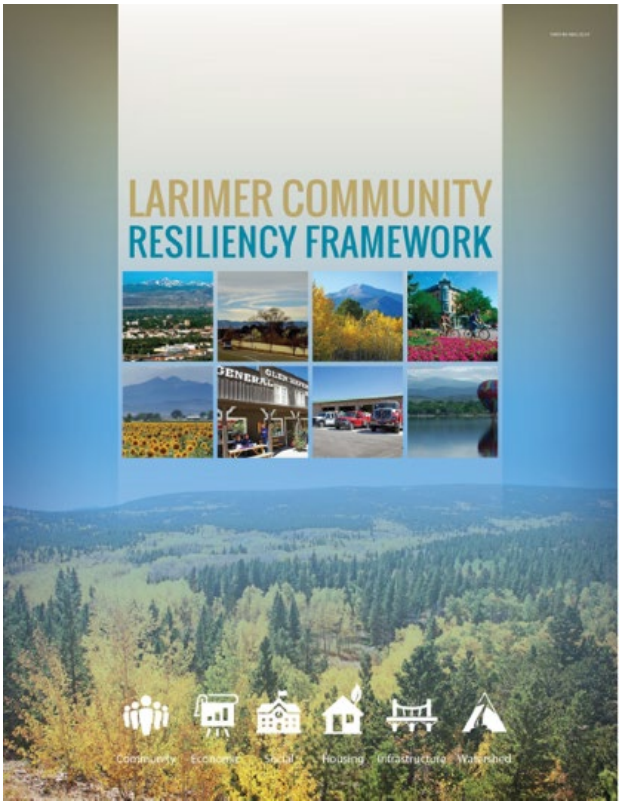
Beyond the Basics: Best Practices in Local Mitigation Planning
mitigationguide.org

Resiliency Planning

Hazards Addressed

How it Works

Planning for resilience empowers diverse stakeholders to evaluate plans, set strategic policies, and implement projects that will enable communities to adapt and thrive when faced with challenges. Natural and human-caused hazards constitute some of the acute "shocks" to which a community can be vulnerable. Other disruptive threats include longer-term societal "stresses," such as unemployment, poor access or barriers to education, crime, or homelessness. Resiliency planning can include updating land use codes, zoning, development standards, incentive programs, and other plans or policies to better prepare for likely shocks and stresses while also developing measures that allow for action in the face of uncertainty or unexpected events.



After the 2012 wildfires and 2013 floods, many Colorado communities began considering not only how to rebuild damaged homes, businesses, infrastructure, and community assets, but also how to develop long-term strategies for resilience. This catalyst has made Colorado a leader in the development of resilience planning approaches and tools.

What is Resilience?

The State of Colorado published the Colorado Resiliency Framework in 2015, which defines resilience as "the ability of communities to rebound, positively adapt to, or thrive amidst changing conditions or challenges – including disasters and climate change – and maintain quality of life, healthy growth, durable systems, and conservation of resources for present and future generations." Other leaders in the field of resilience have similar definitions of resiliency. The Rockefeller Foundation's 100 Resilient Cities initiative defines urban resilience as "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience."

Resilient communities are often characterized as systems that possess the following seven qualities (100 Resilient Cities):

Reflective: using past experience to inform future decisions

Resourceful: recognizing alternative ways to use resources

Inclusive: prioritize broad consultation to create a sense of shared ownership in decision making

Integrated: bring together a range of distinct systems and institutions

Robust: well-conceived, constructed, and managed systems

Redundant: spare capacity purposively created to accommodate disruption

Flexible: willingness and ability to adopt alternative strategies in response to changing circumstances

Projects or policies developed to increase resilience usually fulfill many of the following characteristics (Colorado Resiliency Framework):

Co-Benefits: Provide solutions that address problems across multiple sectors creating maximum benefit

High Risk and Vulnerability: Ensure that strategies directly address the reduction of risk to human well-being, physical infrastructure, and natural systems

Economic Benefit-Cost: Make good financial investments that have the potential for economic benefit to the investor and the broader community both through direct and indirect returns

Social Equity: Provide solutions that are inclusive with consideration to populations that are often most fragile and vulnerable to sudden impacts due to their continual state of stress

Technical Soundness: Identify solutions that reflect best practices that have been tested and proven to work in similar regional context

Innovation: Advance new approaches and techniques that will encourage continual improvement and advancement of best practices serving as models for others in Colorado and beyond

Adaptive Capacity: Include flexible and adaptable measures that consider future unknowns of changing climate, economic, and social conditions

Harmonize with Existing Activity: Expand, enhance, or leverage work being done to build on existing efforts

Long-Term and Lasting Impact: Create long-term gains to the community with solutions that are replicable and sustainable, creating benefit for present and future generations

Approaches for Integrating Resilience into Planning and Land Use Decisions

Resiliency planning is an emerging and far-reaching concept, with various approaches for appropriately integrating resilience into community planning and land use.

Integrate Resilience into the Comprehensive Plan

As the comprehensive plan serves as the community's long-term policy blueprint, it is valuable to draft or update the comprehensive plan with resilience as an interwoven or guiding theme. This allows a community to construct their own vision of what it means to be "resilient," as well as identify and prioritize action items that increase resilience. The process for incorporating resiliency into a comprehensive plan can be achieved by following the steps outlined in the Comprehensive Plan tool profile of this Guide. A resilient comprehensive plan encompasses natural and human-caused hazards (the "shocks" to a community), while also addressing the social, environmental, and economic "stresses" into the goals and strategies. To achieve this, comprehensive planning efforts should be informed by a risk assessment that includes identification of hazards and existing or potential stresses.

The **City of Longmont** updated their comprehensive plan in 2016 using a systems approach with sustainability and resilience woven throughout the plan. Other examples of comprehensive plans that address hazard risk reduction and resilience can be found in the Comprehensive Plan tool profile of this guide.

Develop a Stand-Alone Resiliency Framework or Plan

This approach may be helpful if multiple jurisdictions are coming together to develop strategies for resilience, or if a community seeks to develop and apply a consistent "resilience lens" across multiple initiatives, processes, or departments. A resiliency framework, plan, or strategy can also provide guidance if a comprehensive plan update is not scheduled to occur in the near future. The development and implementation of a stand-alone resiliency plan requires many stakeholder groups to come together, establish a common vision for resilience, and share responsibility for certain aspects of community resilience.

Initiatives such as the Rockefeller Foundation's *100 Resilient Cities* have developed frameworks and guiding documents to support towns and cities in becoming more resilient. Twenty four U.S. cities were selected to participate in the 100 Resilient Cities initiative, and many, such as the City of Boulder, Colorado, have developed resiliency plans.

In December of 2016, the **City of Boulder** adopted their Resilience Strategy, which identifies Boulder's core resilience challenges and develops a framework for tackling those challenges. The document outlines fifteen actions to further three strategies, including "connect and prepare," "partner and innovate," and "transform and integrate." Additionally, the Resilience Strategy highlights three "frontiers," or long-term, transformative investments in Boulder's future.

Other Colorado communities that are developing region-wide resiliency plans include **Larimer**, **El Paso**, and **Boulder Counties**. In 2015, with assistance from the Colorado Resiliency and Recovery Office, each of these communities held several planning sessions over a six-month period of time to discuss actions they can undertake to improve their collective resilience.

Participant stakeholders from each county included county and municipal agencies, state and federal partners, emergency response and recovery organizations, locally-based research institutions, non-profit and faith-based organizations, and private sector partners.

The Colorado Resiliency Framework planning process consisted of the following steps:

(Insert website chart)

- Establish a vision of resilience for the community.
- Document existing conditions in the community.
- Review the shocks and stresses to understand vulnerabilities the community faces.
- Develop forward-looking goals, actionable strategies, and priorities.
- Provide a framework for ongoing implementation and action for communities to build capacity, increase community connectivity, and move forward toward a more-resilient future.

The Colorado Resiliency Resource Center's Resiliency Framework webpage has more detailed information and guidance on developing local resiliency frameworks.

Conduct a Resilience Audit of Existing Plans and Policies

Another approach for assessing and promoting resilience is to conduct an audit or evaluation of plans and land use policies that already guide the functioning and operation of the community. This enables a community to identify possible inconsistencies among plans, policies, and programs that can be addressed to increase resilience to both shocks and stresses. Below are several examples of audits that can be tailored to a community's existing conditions.

A 2015 article published in the Journal of the American Planning Association (JAPA) details the development of a resilience scorecard that maps the physical and social vulnerabilities of the community to hazards. It then evaluates different types of local plans that govern land use to determine whether the goals reduce or increase vulnerability to hazards. Using the city of Washington, North Carolina as a pilot community, the authors first delineate the city's planning districts and hazard zones using the comprehensive plan, land use map, and FEMA flood maps, also accounting for future conditions projections. Next, vulnerability is determined by applying data from building tax rates and the Social Vulnerability Index for Disaster Management of the U.S. Centers for Disease Control. Finally, each policy in each plan is evaluated for how it affects physical planning districts and hazard areas and whether it increases or decreases vulnerability to hazards. The level of consistency of policies across plans is also evaluated.

Published in 2009 by the American Planning Association in issue 10 of Zoning Practice, the *Safe Growth Audit* remains another valuable tool for ensuring that comprehensive plans, zoning, capital improvement programs, subdivision regulations, building codes, and more are promoting policies that reduce the vulnerability of communities to hazards. This process involves reading and evaluating all relevant plans and policies, and answering targeted questions about how they promote hazard mitigation. The author, David R. Godschalk, FAICP, also outlines several common principles of safe growth that should be carried out by communities:

- Guide growth away from high-risk locations
- Locate critical facilities outside high-risk zones
- Preserve protective ecosystems
- Retrofit buildings and facilities at risk in redeveloping areas
- Develop knowledgeable community leaders and networks
- Monitor and update safe growth programs and plans

Refer to issue 10 of Zoning Practice for the full list of *Safe Growth Audit* questions. While the *Safe Growth Audit* focuses primarily on resilience to hazards, this approach can easily be expanded to include questions regarding social and economic resilience specific to community stresses. Example audit questions include:

- Does the comprehensive plan set forth policies to reduce the number of housing units that are not up to code and/or vulnerable to natural hazards?
- Does zoning density encourage the construction of affordable housing in non-hazardous areas?

The Environmental Protection Agency's Smart Growth Implementation Assistance program in Vermont developed a Flood Resilience Checklist to "help communities identify opportunities to improve their resilience to future floods through policy and regulatory tools, including comprehensive plans, Hazard Mitigation Plans, local land use codes and regulations, and non-regulatory programs implemented at the local level." Some examples of questions asked in the *Flood Resilience Checklist* include:

- Does the comprehensive plan cross-reference the local Hazard Mitigation Plan and any disaster recovery plans?
- Has the community implemented non-regulatory strategies to conserve land in river corridors, such as:
    - Acquisition of land (or conservation easements on land) to allow for stormwater absorption, river channel adjustment, or other flood resilience benefits?
    - Buyouts of properties that are frequently flooded?
    - Transfer of development rights program that targets flood-prone areas as sending areas and safer areas as receiving areas?
    - Tax incentives for conserving vulnerable land?
    - Incentives for restoring riparian and wetland vegetation in areas subject to erosion and flooding?
- Do land development regulations and building codes promote safer building and rebuilding in flood-prone areas? Specifically:
    - Do zoning or flood plain regulations require elevation of two or more feet above base flood elevation?
    - Does the community have the ability to establish a temporary post-disaster building moratorium on all new development?
    - Have non-conforming use and structure standards been revised to encourage safer rebuilding in flood-prone areas?
    - Has the community adopted the International Building Code or American Society of Civil Engineers (ASCE) standards that promote flood-resistant building?
    - Does the community plan for costs associated with follow-up inspection and enforcement of land development regulations and building codes?

Advantages and Key Talking Points

- A resiliency plan or audit provides the community with an understanding of policies, programs, and other actions that can be taken across many sectors to improve the community's resilience to hazards or changing conditions.
- Planning for resilience can reduce future disaster related response and recovery costs and improve recovery time following natural or human-caused hazard events.
- Planning for resilience can help anticipate and reduce the severity of economic downturns and other stresses.
- Resilience can be interwoven into any planning process in the community, such as an economic development plan, hazard mitigation plan, or parks and recreation plan.

Challenges

- Since resilience spans across many sectors, it may be challenging to secure sustained participation and support from all relevant stakeholders.
- Strategies that may promote resilience in one sector (such as increasing affordable housing) may conflict with another component of resilience (such as prohibiting development in high-hazard areas) without consistent coordination.

Key Facts

Administrative capacity	Varies depending on approach. Requires staff time and taskforce to create and implement the plan.
Mapping	May be needed to analyze shocks and stresses with a spatial dimension
Regulatory requirements	None required
Maintenance	Review annually to track progress; updates are community dependent and may be prompted by a major disaster event, significant changes in community existing conditions, updates to related plans (e.g., hazard mitigation plans), and completion of a significant number of recommendations identified in the plan
Adoption required	No, though strongly encouraged if plan is developed
Statutory reference	N/A
Associated costs	Dependent on scale and level of complexity. Could include staff time, plus potential costs for mapping or other technical work, public outreach activities, and consultant services. Could also include applying resilience criteria to existing budgeting processes.

Examples

Longmont, CO Envision Longmont Comprehensive Plan	https://envisionlongmont.com/document/envision-longmont-adopted-062816
City of Boulder Resiliency Strategy	https://bouldercolorado.gov/resilience
Larimer County Community Resiliency Framework	https://www.larimer.org/sites/default/files/larimer_resiliency_framework.pdf

For More Information

100 Resilient Cities
http://100resilientcities.org/#

American Planning Association: Zoning Practice, Issue 10. Practice Safe Growth Audits (October 2009)
http://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/zoningpractice/open/pdf/oct09.pdf

Colorado United: Local Resiliency Initiatives
https://sites.google.com/a/state.co.us/coloradounited/resiliency/local-resiliency-initiatives

Colorado Resiliency Resource Center: Resiliency Frameworks and Community Worksheets
https://www.coresiliency.com/resiliency-frameworks

Colorado Resiliency Framework

https://sites.google.com/a/state.co.us/coloradounited/resiliency-framework

EPA Flood Resilience Checklist
https://www.epa.gov/sites/production/files/2014-07/documents/flood-resilience-checklist.pdf

Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard. Journal of the American Planning Association (November 2015)
https://tandfonline.com/doi/full/10.1080/01944363.2015.1093954

Resilient Communities Starter Kit
https://sonoraninstitute.org/resource/resilient-communities-starter-kit/

Rural Economic Resilience Study
https://choosecolorado.com/wp-content/uploads/2016/07/Resiliency-Study.pdf

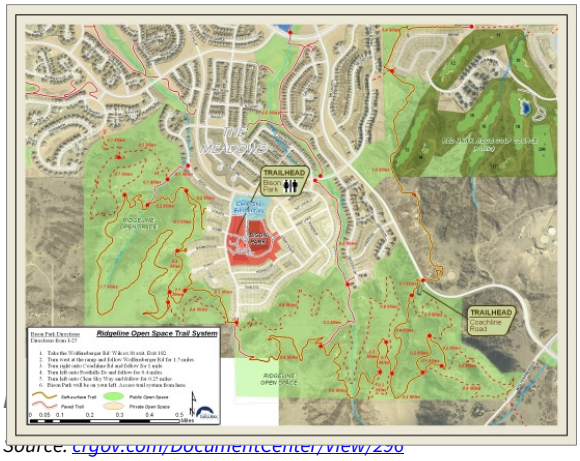
Parks and Open Space Plan


Source: Jefferson County

Hazards Addressed

How it Works

Parks and open space plans are intended to guide a systematic approach for communities to provide and preserve parks, undeveloped lands, and recreation services for the public good. While all comprehensive plans adopted by Colorado communities are required to include a recreation and tourism element, many choose to develop a separate, complementary parks and open space plan that includes more detailed information. Parks and open space resources within a community may include natural, scenic, cultural, historic, and recreational features or amenities. While such resources often are dispersed, communities increasingly are attempting to build interconnected park and open space systems linked by trails, greenways, or other public corridors.



Source: ergov.com/DocumentCenter/View/296

The development of a parks and open space plan is often spurred by the desire to enhance public functions such as environmental protection, outdoor recreation, and growth management, thus shaping future development patterns to meet community needs while preserving areas in their natural state. **Parks and open spaces often overlap with critically sensitive or hazardous areas such as floodplains, steep slopes, or areas**

prone to wildfire. This provides communities with unique opportunities to pursue the mitigation of natural hazards by avoiding development in these areas jointly with other community goals through the implementation of their parks and open space plan. Multi-benefit solutions have the additional advantage of being more likely to be supported by elected officials and the community at-large, and could even help leverage outside technical or non-traditional funding assistance.

Some common examples of how parks and open space plans dovetail with hazard mitigation goals include:

- **Mitigation of flood hazards**. Parks and lands preserved as open space play a critical role in flood risk reduction. Prohibiting development in known flood hazard areas is the only sure method to minimize future flood losses with little to no residual risk. This strategy is often employed along rivers and streams that are also very appealing areas for:
    - Creating parks and recreational assets such as picnic areas, hiking trails, and bicycle paths;
    - Providing riparian buffers and other green infrastructure assets for improving water quality and stormwater management; and
    - Preserving or enhancing the natural and beneficial functions of floodplains.

  The acquisition and demolition or relocation of existing flood-prone structures is also a common technique for communities seeking to reduce flood risk and synergize the efforts with other compatible goals as expressed in the parks and open space plan. In addition, the use of parks and other undeveloped lands for stormwater detention or retention practices can serve not only as a flood mitigation technique but also as a means to conserve water, improve water quality, increase biodiversity, or enhance aesthetics.
- **Mitigation of geologic and other hazards**. Many communities have adopted plans for parks and open space to support the acquisition or conservation of lands that also happen to be in hazardous areas, such as mountainous locations that are subject to landslides, avalanches, or wildfires. These areas are preserved not only for their aesthetic and ecological value, but also to support economic development opportunities that are associated with park and recreational amenities. Parks and open space plans are ideally suited for promoting synergies between these values and linking the added benefits of public safety by discouraging the development of lands facing dangerous geologic conditions or wildfire threats.

Integrating Hazard Mitigation into the Plan

Much like any other planning document, parks and open space plans vary widely in terms of format, organization, and level of detail, based on the goals of the jurisdiction and the resources available to support the planning effort. Most parks and open space plans contain the following components, or some variation:

- **Inventory of assets** – What is the current total amount of parks, open spaces, trails, and recreation areas and facilities? Where are they located? Where are there gaps in the system? Are assets located in hazard areas?
- **Policies** – How should the community address issues related to parks and open space? Should additional investments and land acquisitions occur outside of hazard areas? Is increased maintenance a priority? Should the community consider sharing resources?
- **Priorities and recommendations** – What are the specific steps a community can take to address a stated issue? Are there gaps in the system that should be treated as priorities? Should areas outside known hazard areas be given higher priority than others?

These elements are described below, including example policy language to integrate hazard mitigation, where applicable.

Inventory of Park and Open Space Assets

When identifying existing parks, open space, trails, and recreation areas, it is important to recognize the synergies between conservation of those areas and hazard mitigation.

The **Town of Frederick's** *Open Space Inventory* includes a table that identifies which open spaces and greenways are used for drainage or detention. The far right column on the table below indicates uses for drainage and detention.

Town of Frederick P.O.S.T. Master Plan
Open Space Inventory / Analysis

Good ● Average ◒ Poor ○

	Quality/Aesthetic Value	Access / Accessibility	Help Protect Wildlife	Access Water/Wetland	Recreational Opportunities	Intrusion (lighting, sound, visual)	External Connectivity (On Trail)	Used for Drainage (Detention)
Angel View Estates	○	●	○	○	○	○	○	Detention
Bulrush Wetlands	●	◒	●	●	●	●	○	100 Year Floodplain
Creekway Greenway	●	◒	●	●	●	◒	○	100 Year Floodplain
Eagle Valley Greenway	●	●	●	○	●	●	●	100 Year Floodplain
Fox Chase Open Space	◒	○	◒	○	○	●	●	No
Fox Run Greenway	○	◒	○	○	○	◒	●	East Parcel Detentio
Moore Farm Open Space	●	●	●	●	●	◒	●	Detention
Nelson Lakes Open Space	●+	◒	●	●	◒	●	○	100 Year Floodplain
Prairie Greens Greenway	○	◒	○	◒	○	◒	○	Detention/Channel
Savannah Greenway	◒	◒	○	○	○	○	●	No
Summit View Estates Open Space	○	●	○	○	○	◒	●	NW Parcel Serves as Drainage
Wildflower Greenway	○	○	◒	○	○	●	○	Detention
Wyndham Hill Northeast Open Space	◒	○	◒	○	○	◒	○	No

The Town of Frederick's Open Space Inventory Analysis indicates which open spaces are used for drainage and detention.

Source: Town of Frederick frederickco.gov/index.aspx?nid=354

The **Colorado Springs** *Park System Master Plan* dedicates an entire section of its inventory of park/open space assets to recognizing the impacts of natural events such as drought, fire, and flood. The plan states, for example:

- Increased wind erosion of soils and poor soil quality
- Forest and vegetation quality degradation
- Increased risk of wildfires
- Loss of wetlands and aquatic habitats for wildlife
- Loss of water-related recreation activities
- Need for increased watering of turf and plant materials to prevent loss"

Developing comprehensive maps is an important tool for summarizing and communicating the results of the park and open space inventory. Maps should show the inventory of existing assets described above, along with providing analysis (e.g., access to parks/open space from residential neighborhoods, identification of gaps in the overall parks and open space system). Maps will also help identify future projects or acquisition areas. Natural hazard areas should be included in this mapping process, recognizing the linkages between conservation of open space and risk reduction to property and life. Areas to potentially identify in plan maps include:

- Steep slopes
- Flood hazard areas
- Wildland-urban interface
- Subsidence zones
- Avalanche paths
- Unstable soils
- Other geologic hazard areas

"Drought can have significant impacts on parks, open space, and recreation sites:
North Cheyenne Canyon Park, Colorado Springs, CO.

Source: Miguel Vieira

Policies

Parks and open space plans use the inventory of assets and identification of issues and gaps in service to develop policies to help achieve the goals of the plan. Those policies can include statements related to reducing risk and hazard mitigation. Some examples of policies that address hazard areas include:

- Encourage the use of floodplains and major drainage facilities for recreational use, open space, and other appropriate uses that preserve the natural environment and minimize the potential for property damage.
- Work with experts to ensure there is an adequate buffer between development and natural areas, water bodies, wetlands, and floodplains.

- Maintain adequate buffers through open space preservation to allow high-hazard landscapes to function in a natural way with minimal human intervention and modification.
- Strengthen safety and security in the community's parks, open space, and recreation areas by addressing flood, fire, drought, and other hazard issues.
- Design park facilities to preserve natural features that help control stormwater and minimize the introduction of new structural features and impervious surfaces.

Priorities and Recommendations

Much like a comprehensive plan, the parks and open space plan typically establishes recommendations and strategies to achieve the stated policies and goals of the plan, such as:

- Review floodplain regulations and revise, as appropriate, to encourage recreational and open space uses within floodplains.
- Review floodplain regulations to ensure they sufficiently limit the amount a floodplain can be modified when considering current and future parks, open spaces, and recreation areas.
- Prioritize acquisition of riparian corridors for open space preservation to achieve multiple benefits (e.g., trail connectivity, stormwater management, habitat preservation, and recreation).
- For [*specific park or open space*], provide a trail surface that can stand up to intermittent flooding during high water events in an effort to reduce ongoing maintenance requirements.
- For steep slopes, allow adequate separation from developed landscapes.
- For fire zones, provide demarcation or buffer zones between development landscapes and natural forests.
- Land not suitable for development or passive recreation within new development proposals due to steep slopes, poor soils, floodplain areas, or other hazards should be maintained as deed-restricted private open space and not accepted as publicly dedicated open space.
- Landscape conditions caused by natural hazards (flooding, erosion, or wildfires) may be modified for habitat restoration, public safety, or the reconstruction of public facilities such as trails or cultural resources.

Where It's Been Done

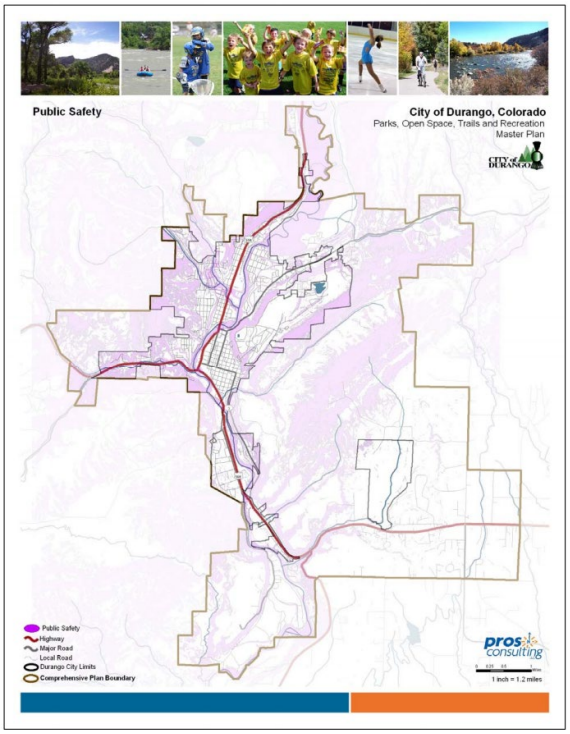
The **Colorado Springs** *Park System Master Plan* includes an entire page of recommendations to address floods, fires, and drought, including:

- Develop fire mitigation partnerships and create natural area management plans with land managers, utility providers, public safety officials and State Parks representatives.
- Work with natural resource managers of wildlife habitat to balance wildlife needs with management for fire, floods, and drought.

- Refer to the [drainage and stream buffer standards or guidelines] for recommendations regarding floodplain treatments, vegetation management, stream bank stabilization, and other elements that mitigate flood events.
- Provide education and enforcement to address unintentional forest fire starts and arson.
- Form stormwater, floodplain, and vegetation management partnerships with flood control districts, watershed managers, City and County public works departments, ditch companies, and other land managers.
- Install more drought-tolerant plant materials and reduce park dependency on water resources.
- Identify and re-route trails that are susceptible to frequent damage from flooding.

Durango adopted its *Parks, Open Space, Trails and Recreation Master Plan* in 2010 as a comprehensive update to its first plan that was completed in 2001. The primary purpose of the updated Master Plan was to establish a 10-year road map to provide strategic direction to the City over the course of the coming decade, and an important underlying factor to help guide this direction is protecting public safety. This guiding principle is reflected throughout Durango's plan and is specifically addressed under its objectives and priorities for open space, where it states that steep slopes and hazardous landscapes should remain undeveloped where possible. It further clarifies how to achieve this objective by stating the following:

> *"Maintain sufficient buffer to allow these high hazard landscapes to function in a natural way with minimal human intervention/modification. Recognize that these are natural processes. Allow the geomorphology of the creeks and rivers to meander naturally. For steep slopes, allow adequate separation between developed landscapes. For fire zones, provide demarcation or buffer zones between developed landscapes and natural forests."*



This public safety map is an excerpt from Durango's Parks, Open Space, Trails, and Recreation Master Plan. The plan's "greenprinting" process uses GIS maps like this (which shows floodplain areas in purple) to help inform decision making regarding open space, preservation, and resource conservation.

Source: durangogov.org/index.aspx?NID=554

The protection of public safety and preservation of areas subject to natural hazards was further incorporated into Durango's plan through a "greenprinting" process, a GIS-based tool that graphically depicts areas within the city that are deemed potentially high value and should be considered for protection. One of the key categories (or layers) used to generate greenprinting scores in this process is Public Safety, which identifies those parcels with defined flood hazards and/or steep slopes. Such parcels are representative of a priority concern that makes them more valuable in terms of protection through open space preservation and resource conservation.

Teller County adopted its *Parks, Trails and Open Space (PTOS) Master Plan* in 1997 to summarize the main goals, policies, standards, and facilities recommendations for parks, trails and open space that are under its jurisdiction. While an older document, it is one of the best examples of a community that has addressed hazard risk reduction in its park and open space plan.

The plan was adopted after many years of effort by the County's Parks Advisory Board and community residents and was designed to meet the needs of the County well into the future and be actively coordinated with County growth management plans. In describing the physical setting of the County, the Plan emphasizes the flood control value of water features that "should be given a high priority to maintain as open space." It also states that environmentally sensitive areas including wetlands, floodplains, major faults, and extreme slopes preclude most development for safety reasons as well as environmental concerns,

though all may be suitable for consideration as open areas, parks, or trails. **In identifying and mapping areas of open land suitable for protection, the plan establishes "Environmental Hazard Areas" as the first factor for consideration, including floodplains, areas with a slope greater than 25%, and geologic hazards such as known fault lines.**

In more recent years Teller County has amplified the importance and value of risk reduction in its parks and open space planning efforts by linking them with its *Multi-Hazard Mitigation Plan* (2008). For example, this includes establishing an objective to "expand…the PTOS Master Plan and implement an open space plan to protect natural resources, wildlife, wetlands, slopes, ridgelines, views, and cultural sites" and a specific policy statement to "encourage low density, nonstructural open space uses that are least subject to loss of life and property damage in flood hazard areas."

Advantages and Key Talking Points

By preparing and maintaining a parks and open space plan, communities will clearly articulate their commitment and strategy to preserving and enhancing specific assets or lands that serve multiple purposes. Primary benefits include:

- Serves as a powerful project implementation tool for hazard mitigation or avoidance – especially with regard to competing land development interests.
- Promotes multi-objective planning for parks and open space properties that intersect with hazard areas.
- Can complement and provide more robust analysis and information on parks and open space than found in the community's comprehensive or master plan.
- Specific policy statements and pre-identified parks and open space projects that promote public safety can support more creative and competitive applications for grant funding.
- A parks and open space plan can set the policy foundation for a land acquisition and/or Transfer of Development Rights (TDR) program.

Challenges

The development of parks and open space plans, as well as integrating hazard considerations into such plans, requires dedicated trained staff time or funding to hire a consultant. Other related challenges include:

- Can be challenging to implement or administer without dedicated parks planning staff.
- Some technical mapping and analysis of hazard areas may be required.
- Funding for plan implementation activities may be inadequate or difficult to obtain, particularly for the acquisition of private, developable properties.
- Plans should be updated and maintained on a regular basis, concurrent with comprehensive or master plan updates, and perhaps even more frequently for communities experiencing rapid changes through growth and land development.

- The timing of the preparation of parks and open space plans may not overlap with the development of a hazard mitigation plan. This means planners must make a concerted effort to promote coordination between the goals, policies, and actions of both efforts, as well as other related plans.

Key Facts

Administrative capacity	Planner, parks and recreation staff
Mapping	Some technical mapping and GIS analysis may be required for integrating hazard areas and to support the supply inventory, demand assessment, or surplus/deficiency analysis
Regulatory requirements	None required, but can support plan implementation
Maintenance	Should be updated at a regular time interval, preferably every five years
Adoption required	Yes
Statutory reference	N/A
Associated costs	Staff time, plus potential costs for mapping or other technical work, public outreach activities, and consultant services

Examples

Town of Basalt Parks, Open Space, and Trails Master Plan	basalt.net/193/Parks-Open-Space-Trails-Master-Plan
City of Colorado Springs Parks System Master Plan	parks.coloradosprings.gov/sites/default/files/parks_recreation_and_cultural_services/cos_masterplandocument_140923-view.pdf
Douglas County 2030 Parks, Trails, and Open Space Master Plan	douglas.co.us/land/comprehensive-master-plan/parks-trails-and-open-space-master-plan-ptos-plan
City of Durango Parks, Open Space, Trails, and Recreation Master Plan	http://durangogov.org/554/POST-Recreation-Master-Plan
Town of Erie Parks, Recreation, Open Space, and Trails Master Plan	erieco.gov/825/PROST-Master-Plan

City of Fort Collins Natural Areas Master Plan	https://www.fcgov.com/naturalareas/plans-policies
Town of Frederick Parks, Open Space, and Trails Master Plan	https://frederickco.gov/354/Parks-Open-Space-Trails-Master-Plan
Jefferson County Open Space Master Plan	jeffco.us/open-space
Johnstown/Milliken Parks, Trails, Recreation, Open Space Master Plan	http://townofjohnstown.com/DocumentCenter/View/34/Parks-Trails-Rec--Open-Space-Master-Plan?bidId=
Teller County Parks, Trails, and Open Space Master Plan	co.teller.co.us/CDSD/Planning/TC%20ParksTrailsOpenSpaceMasterPlan.pdf

For More Information

Colorado Parks and Wildlife

cpw.state.co.us

Colorado Department of Local Affairs, Conservation Trust Fund Website

colorado.gov/pacific/dola/conservation-trust-fund-ctf

Pre-Disaster Recovery Planning


Source: Nathan Slaughter

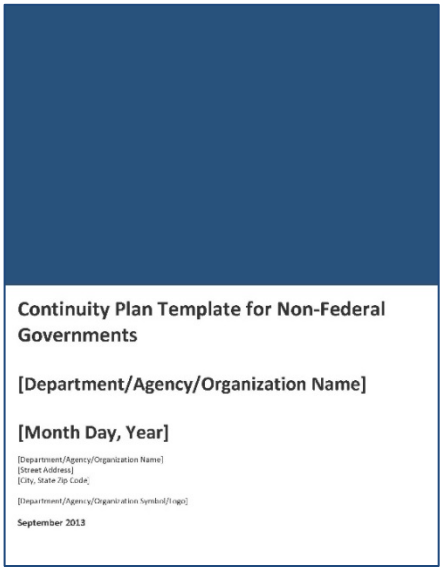
Hazards Addressed

How it Works

Pre-disaster recovery planning is an opportunity for communities to consider how they will manage important recovery issues, like how to keep the government and essential services up and running, where to locate temporary housing, how and where they will rebuild, and how to reestablish essential economic activity. Communities can, and should, take steps before being impacted by a disaster to ensure that the aftermath of the disaster will not become a disastrous and chaotic situation in itself.

Three types of community plans available to local governments are particularly important for helping smooth the road to post-disaster recovery.

1. **Pre-disaster Recovery Plans** help increase the recovery capacity of communities and their governments by creating an organizational framework for decisions and actions taken post-disaster (FEMA 2017). Pre-disaster recovery planning is typically a broad-based, inclusive process that builds upon existing community plans and aligns with other hazards plans and policies. The process of developing a plan helps communities to understand their existing


Continuity Plan Template for Non-Federal Governments

[Department/Agency/Organization Name]

[Month Day, Year]

[Department/Agency/Organization Name]
[Street Address]
[City, State Zip Code]

[Department/Agency/Organization Symbol/Logo]

September 2013

FEMA Guidance Document for Developing COOP plan.

Source: FEMA

resources and needs, recognize opportunities for long-term hazard mitigation and resilience building, and establish relationships and processes to ensure a faster and more organized recovery process in the event of a disaster. Crucially, pre-disaster recovery plans identify leadership for the recovery process, as well as the key responsibilities for local government agencies and staff. According to FEMA (2017) and the American Planning Association (2014) there are numerous benefits to pre-disaster recovery planning that include:

a. faster and more efficient disaster recovery;

b. the establishment of clear leadership and decision-making structures for post-disaster recovery;

c. improved ability to access recovery resources; and

d. increased community participation in disaster recovery and community resilience efforts.

2. **Continuity of Operations Plans (COOP)** can be developed to ensure that citizens do not experience significant disruption of services during and following times of emergencies and or disasters. FEMA defines COOPs as: “an effort within individual executive departments and agencies to ensure that Primary Mission Essential Functions (PMEFs) continue to be performed during a wide range of emergencies, including localized acts of nature, accidents and technological or attack-related emergencies” (Continuity of Operations, 2015).

3. **Continuity of Government (COG)** Plans are similar to a COOP, although their primary focus is to establish defined procedures for allowing a government entity to continue its essential operations following a catastrophic event. COG plans set procedures for preserving facilities, equipment, and records. Many times, a COG plan is part of a more comprehensive COOP.

Pre-Disaster Recovery Plans can lead to a much more organized and efficient approach to a community's post-disaster recovery.

Characteristics of Effective Pre-Disaster Recovery Plans

Pre-Disaster Recovery Plans:

Pre-disaster recovery planning is an emerging best-practice for towns, cities, and counties with a goal of building resilience to hazards, especially as some of these communities are facing the same hazards on a continual basis. There are no standard rules or templates for the development or implementation of pre-disaster recovery plans, and communities have developed their plans in different ways.

The most successful plans do share several common characteristics:

First, they take a holistic approach. While each community’s pre-disaster recovery plan will look different depending on their needs and priorities, it should consider the full range of potential recovery decisions and actions that will be needed in the event of a disaster. Topics addressed in the plan may include “business resumption and economic redevelopment, housing repair and reconstruction, infrastructure restoration and mitigation, short-term

recovery actions that affect long-term redevelopment, sustainable land use, environmental restoration, and financial considerations as well as other long-term recovery issues identified by the community" (Post-Disaster Redevelopment, 2011). Depending on a community's needs and priorities, land use planning tools in this guide, like post-disaster building moratoriums or overlay zones, may be enacted pre-disaster to help shape post-disaster recovery.

Second, pre-disaster recovery plans should be consistent with other community plans, including their comprehensive plan, hazard mitigation plan and/or climate plan. As noted by FEMA (2017), building on and integrating with other community plans avoids "re-inventing the wheel" in pre-disaster recovery plans or creating unnecessary planning conflicts during the recovery period.

Figure: The Cyclical Nature of Planning.

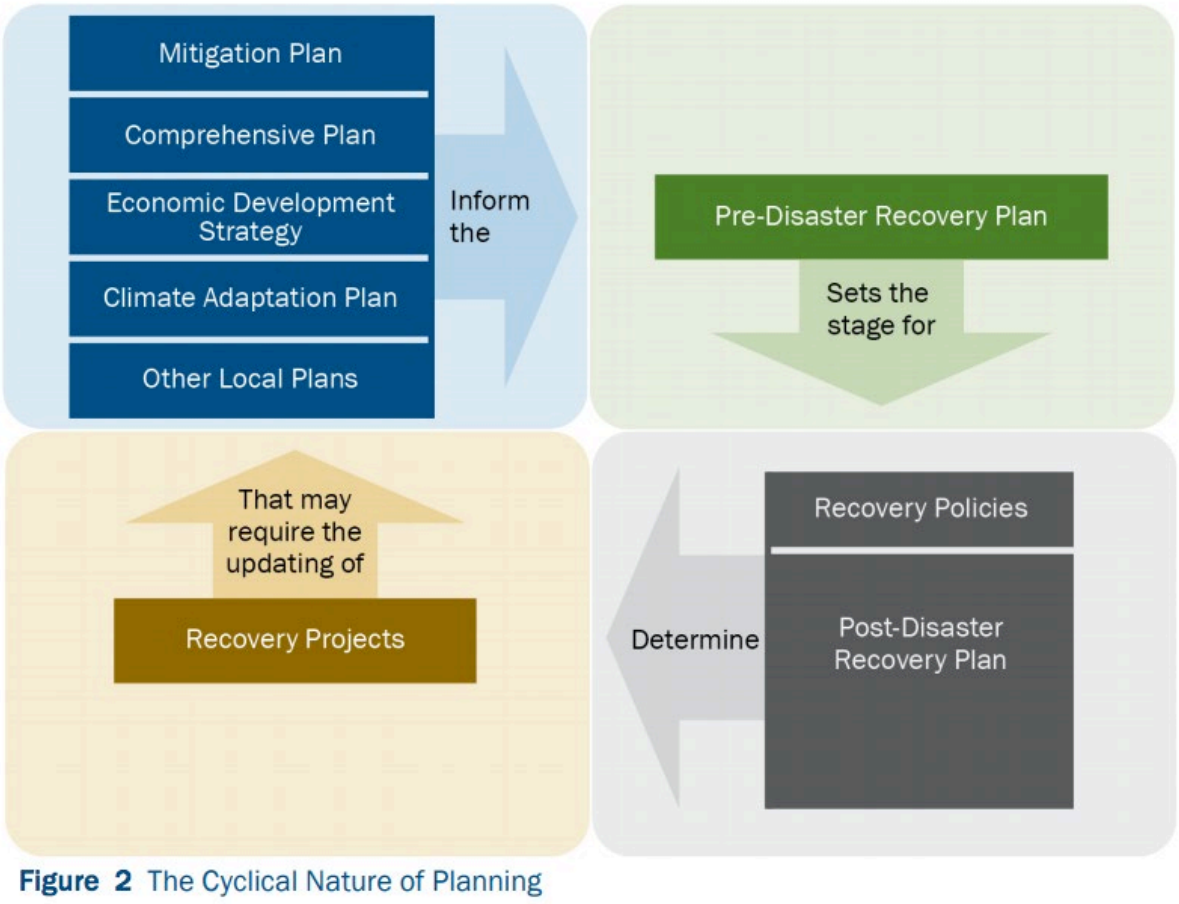


Figure 2 The Cyclical Nature of Planning

Source: FEMA 2017

Third, many pre-disaster recovery plans build linkages to state and federal disaster recovery frameworks, like FEMA's National Disaster Recovery Framework. Salt Lake County's Disaster Recovery Framework, for instance, is organized along the same lines and in the same

functional areas as the federal recovery support functions (RSFs), like Community Planning and Capacity Building and Infrastructure. Establishing these linkages in pre-disaster recovery plans allow communities to better coordinate with state and federal partners during response and recovery and better leverage the external resources that will become available to them.

Fourth, pre-disaster recovery planning requires broad-based participation by local leadership and government officials. While different offices might take the lead in developing a pre-disaster recovery plan, the process itself requires active participation by diverse participants like planners, emergency managers, key departmental staff, town/city managers, and community leaders. Further, a good pre-disaster recovery plan will make links to regional or county-level actors or resources who may provide additional capacity to a community post-disaster.

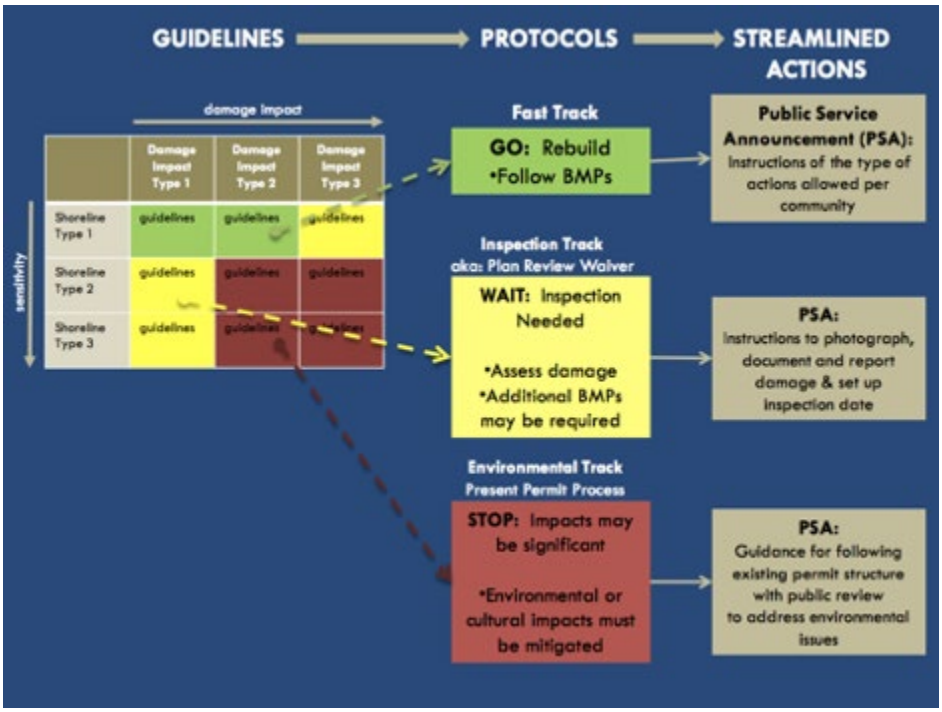
Fifth, pre-disaster recovery plans should involve significant community and stakeholder engagement and outreach. Engaging with communities and stakeholders allows recovery planners to understand the existing (and sometimes contradictory) regulatory conditions and differences between communities or populations in their jurisdiction. Leveraging current planning processes and mechanisms, such as hazard mitigation plan updates, resiliency plans and adaptation plans, are great opportunities to engage the public for pre-disaster recovery planning. The Maui County Planning Department, for instance, carried out an extensive community engagement process that helped shape seven county-wide recommendations at the core of their reconstruction guidelines as well as addressing additional community-specific needs and considerations.

Finally, pre-disaster recovery plans should be flexible and scalable to meet a community's uncertain needs across different types of disasters and recovery processes. Maui County's reconstruction guidelines and protocols, for example, sets forth seven guidelines for recovery that do not have the same force of law as a rule or regulation but are a flexible means to "inform decision makers, set policy, and implement a planning paradigm in the face of uncertainty." Its plan then describes 26 protocols, or instructions on how to implement the guidelines. The result is a streamlined set of recovery actions that are flexible to meet the wide range of hazards that Maui may face while detailed enough to hasten the reconstruction process.

While pre-disaster planning for post-disaster recovery is an emerging best practice, there are useful guides available to Colorado communities. FEMA's Pre-Disaster Recovery Planning Guide for Local Governments and Pre-Disaster Recovery Planning for State Governments define key recovery concepts and lays out a whole-of-community based planning process that aligns with the National Disaster Recovery Framework. The Community

Recovery Management Toolkit further provides guidance, case studies, tools and training for post-disaster recovery planning. The American Planning Association provides several important reports and briefing papers that describe the pre- and post-disaster recovery planning process, and highlight successful case studies from across the United States.

Maui County Disaster Reconstruction Guidelines and Protocols Simplified Flow-Chart



Source: Maui County Planning Department

COOPs and COGs: In many communities, COOPs and COGs are developed by Emergency Management staff; however, the planner has an important role to play. For example, planners can help establish continuity of operations procedures for the Planning Department to be included in the COOP.

The Colorado Department of Homeland Security and Emergency Management maintains several helpful resources for developing COOPs, including a COOP Plan Review checklist, a plan template, and links to FEMA training resources.

Implementation

In many communities, these types of plans are developed by Emergency Management staff; however, the planner has an important role to play in the development of each of these plans. For example, planners can help establish continuity of operations procedures for the

Planning Department to be included in the COOP and there are many planning/land use issues that must be addressed in pre- or post-recovery plans.

Though the recovery plan could be developed after a disaster to guide recovery decisions, these three highlighted plans should ideally be prepared in advance of a disaster. Making the investment in pre-disaster plans that address post-disaster issues will pay dividends for the communities that take the time and initiative to do the planning. These plans should be regularly revisited, especially following an event that would require activation of such plans.

Where It's Been Done

In 2014, officials in **Douglas County, Colorado** adopted the County's first Disaster Recovery Plan. The plan establishes the County's comprehensive framework for managing recovery efforts following a major disaster. The plan aims to "promote mitigation and foster resilient redevelopment and reconstruction" after disasters. As described by Commissioner David Weaver:

> *"Having been through our own wildfires, floods, and other local emergencies, as well as having witnessed other counties navigate their own incidents, our staff had the foresight to recognize the importance of collaboration among our partners to assemble a recovery plan," (County adopts Disaster*, 2015).

The plan describes how the County will use education, incentives, and regulation to reduce vulnerability to hazards and foster more resilient land use patterns and building practices, while also deferring to existing deliberative plans like the Douglas County Comprehensive Master Plan and Hazard Mitigation Plan. The County had also previously developed a Continuity of Operations Plan that is referenced throughout the Disaster Recovery Plan. This helps emphasize the importance of having both types of plans to facilitate successful disaster preparedness and recovery efforts.

Salt Lake County, Utah completed their disaster recovery framework in 2016, which will assist the county to achieve a "focused, timely and expeditious recovery from a disaster." The plan addresses risk from natural, technological, and man-made hazards and is designed as a companion document to the Salt Lake County Emergency Operations Plan. The framework describes a flexible and adaptable coordinating structure for disaster recovery roles and responsibilities, and describes capabilities and resources available at the local, regional, state, and federal level. Functionally, the plan is divided into eight

State of Florida's Post-Disaster Redevelopment Planning Initiative.

Source: State of Florida Division of Emergency Management

recovery areas, corresponding to the state and federal disaster recovery framework.

Maui County, Hawaii developed disaster reconstruction guidelines and protocols to help streamline the repair of homes, businesses, structures, and private property post-disaster while also protecting sensitive environmental and cultural resources. Through pre-disaster recovery planning, the County is able to expedite their rebuilding after disasters without making "arbitrary and capricious decisions" and to incorporate mitigation and adaptation strategies to increase long-term community resilience.

Some of the nation's most progressive pre-disaster planning examples and resources come from the **State of Florida's *Post-Disaster Redevelopment Planning (PDRP) Initiative*** (2010). The purpose of the Initiative, which lasted from 2007-2012, was to develop and test guidelines for a planning process to be applied in the pre-disaster environment to ensure the effective and timely implementation of post-disaster policies that result in more sustainable, resilient communities. While the resulting guidebook can certainly be helpful to Colorado communities, the subsequent plans and policies from the initial pilot PDRP communities provide real-world examples for a variety of local governments dealing with a variety of post-disaster scenarios. This includes the adoption of some advanced and fairly bold planning strategies designed to disinvest and steer redevelopment from known hazard areas to safer locations as opportunities arise through future disaster events. For instance, **Hillsborough County** established the concept of Priority Redevelopment Areas (PRAs) which essentially pre-identifies locations within the community to receive focused and prioritized attention for redevelopment to promote rapid recovery and facilitate the growth of disaster resilient centers of activity. The implementation of this concept would likely rely on the transfer of development rights (TDR) and similar tools as a means of shifting growth and development from one area of a community to another.

Advantages and Key Talking Points

- Each of these plans can help a community more effectively and efficiently respond to disasters. These plans can inform decision-makers and reduce reactionary decisions (and thus, lead to less confusion) in the post-disaster environment.
- Pre-disaster recovery plans allow communities to discuss reconstruction policies and procedures in the less contentious and more deliberative pre-disaster environment.
- A pre-disaster recovery plan can strengthen a community's applications for post-disaster funding, as it demonstrates a clear and carefully considered path to recovery. It also helps to ensure more rapid and effective access to state and federal recovery resources.
- Pre-disaster recovery planning helps to increase stakeholder and community involvement after a disaster by defining outreach resources and building key relationships.
- By engaging in pre-disaster recovery planning, a community can familiarize themselves with state and federal recovery resources and support structures.

- Adopting a COOP and COG puts a community in an excellent position to maintain essential leadership and services at the time of a disaster.

Challenges

- Each of these plans requires considerable coordination with multiple government departments and often partner organizations and community members. Once developed, the plans will need to be "exercised" (i.e., routinely tested and communicated) so that everyone understands their roles as defined in these plans.
- Keeping COOPs and COGs accurate and updated is imperative. Updates should be conducted consistently and thoroughly.
- As for pre-disaster recovery plans, at this time there is no dedicated federal funding source for communities seeking financial assistance in developing their recovery plan. Communities that are updating their hazard mitigation plans with PDM mitigation grant program support, however, may use the planning process to also include pre-disaster recovery planning.

Key Facts

Administrative capacity	Emergency manager (lead for COOP/COG), planner (lead for recovery plan), department heads, and executive-level government staff
Mapping	COOP: Minimal/ N/A COG: Minimal/N/A Recovery plan: Dependent on whether or not there is a risk assessment or scenario-driven analyses that are done to support the plan
Regulatory requirements	COOP/COG: National Security Presidential Directive-51 (NSPD-51)/Homeland Security Presidential Directive-20 (HSPD-20) Recovery plan: N/A
Maintenance	COOP/COG/Recovery plan: Should be annually updated and exercised. Plan effectiveness should be evaluated after any type of event that would be require the plans to be put in place or tested
Adoption required	COOP/COG/Recovery plan: Adoption is not required but some sort of official acknowledgement of support of the plans by the local governing body can help give greater power to these plans
Statutory reference	See regulatory requirements
Associated costs	Dependent on the level of effort, type of public outreach, and the type of plan (hard copy, digital, web-based, etc.)

Examples

Douglas County Disaster Recovery Plan	douglas.co.us/documents/douglas-county-recovery-plan.pdf
State of Florida Post-Disaster Redevelopment Planning Initiative	https://www.leoncountyfl.gov/pdrp/docs/2PDRP_Presentation_Leon_County_Kick-off.pdf
Maui County Post-Disaster Reconstruction Guidelines	http://files.hawaii.gov/dbedt/op/czm/ormp/working_group/meeting_presentations/wg_presentation_20150604_mauipostdisaster.pdf
Salt Lake County Disaster Recovery Framework	https://slco.org/uploadedFiles/depot/fRD/fEmergency/SLCO_Disaster_Recovery_Framework_for_website_comments.pdf

For More Information- COOPs and COGs

COOPs/COGs: National Security Presidential Directive-51/Homeland Security Presidential Directive-20 (NSPD-51/HSPD-20)
https://fas.org/irp/offdocs/nspd/nspd-51.htm

National Continuity Policy Implementation Plan (NCPIP)
https://www.gpo.gov/docs/default-source/accessibility-privacy-coop-files/January2017FCD1-2.pdf

FEMA Continuity Resources and Technical Assistance
https://www.fema.gov/policy-plans-evaluations

FEMA Continuity Resources Page
https://www.fema.gov/policy-plans-evaluations

For More Information- Pre-Disaster Recovery Plans

American Planning Association, Recovery Planning Resources
planning.org/resources/disaster/

American Planning Association, Planning for Post-Disaster Recovery: Next Generation
planning.org/research/postdisaster

FEMA Community Planning and Capacity Building (CPCG) Recovery Support Function (RSF)
fema.gov/media-library/resources-documents/collections/493

FEMA National Disaster Recovery Framework
fema.gov/national-disaster-recovery-framework

FEMA Pre-Disaster Recovery Planning Guide for State Governments
https://www.fema.gov/media-library-data/1487096102974-e33c774e3170bebd5846ab8dc9b61504/PreDisasterRecoveryPlanningGuideforLocalGovernmentsFinal50820170203.pdf

Florida Department of Community Affairs Post-Disaster Redevelopment Planning: A Guide for Florida Communities
http://edocs.dlis.state.fl.us/fldocs/fldisaster/pubs/2020postdisaster.pdf

Training- Pre-Disaster Recovery Planning
The National Disaster Preparedness Training Center (NDPTC) offers a free, FEMA-certified course on Community Planning for Disaster Recovery https://ndptc.hawaii.edu/training/catalog/22/#course-description (AWR-356). This 8-hour, awareness level class provides facilitated discussions on key concepts for disaster recovery planning including the benefits of pre-disaster recovery planning, its key elements, and the plan development process. Colorado communities can request a delivery of AWR-356 by contacting Andrew Rumbach at the University of Colorado Denver (andrew.rumbach@ucdenver.edu) or the National Disaster Preparedness Training Center https://ndptc.hawaii.edu/contacts/.

Strengthening Incentives

The most successful incentives result in significant cost- and time-savings in exchange for some community benefit.

Incentives are effective strategies for enhancing relationships with the development community, guiding growth and development to desirable areas, and encouraging compliance with community objectives without additional regulation. Incentives can come in the shape of financial savings, increased density, relaxation of regulations, expedited review processes, or waivers of either fees or regulations altogether. For any incentive to work, there has to be good reason for a developer to take advantage of the incentive. This often means careful and thorough analysis of the benefits to be exchanged prior to moving forward for adoption of any such program or tool. A developer will not simply participate in an incentive program because the local government thinks it's a good idea. The most successful incentives result in significant cost- and time-savings in exchange for some community benefit (such as protecting known hazard areas from development). They should be designed to address existing (or perceived) roadblocks to development.

This section explores planning tools and programs that communities can use to encourage development away from known hazard areas by way of incentives. Tools profiled in this section include:

- Community Rating System
- Density Bonus
- Development Agreement
- Transfer of Development Rights

Source: Shutterstock

Community Rating System

Source: Manitou Springs

Hazards Addressed

Flood

How it Works

The **Community Rating System** (CRS) is a voluntary, incentive-based community program that recognizes, encourages, and rewards local floodplain management activities that exceed the minimum standards of the National Flood Insurance Program (NFIP). CRS provides a framework and a variety of technical resources to help participating communities implement a comprehensive flood risk management program designed to reduce and avoid flood losses and to strengthen the insurance aspects of the NFIP. In return, flood insurance rates for existing policyholders community-wide are discounted to reflect the reduced flood risk resulting from community actions.

The CRS program is administered by FEMA with support from Insurance Services Office, Inc. (ISO). It uses a class rating system that is similar to fire insurance ratings to determine flood insurance premium reductions for properties located in and outside of the Special Flood Hazard Area (SFHA). Communities earn credit points based on the local implementation of specific activities recommended in the *CRS Coordinator's Manual*, and the number of points earned determines the CRS class. Classes are rated from 9 to 1, with each incremental improvement providing an additional five percent insurance premium discount. A community in the CRS Class 9 qualifies for a premium reduction in the SFHA of five percent; whereas a community in the CRS Class 1 receives the highest possible reduction of 45 percent.

In total there are nearly 100 distinct activities or elements eligible for credit under CRS, all organized under four categories:

- **Public Information Activities.** This includes local activities that educate people about flood hazards, flood protection, and flood insurance. Activities are typically

directed toward residents, property owners, insurance or real estate agents, or other stakeholders. Examples include elevation certificates, map information service, outreach projects, hazard disclosure, flood protection information, flood protection assistance, and flood insurance promotion.

- **Mapping and Regulations.** This includes activities that exceed the NFIP's minimum standards to offer flood protection for new and existing development. Examples include floodplain mapping, open space preservation, higher regulatory standards, flood data maintenance, and stormwater management.
- **Flood Damage Reduction Activities.** These activities focus primarily on reducing flood damage to existing buildings. Examples include floodplain management planning, acquisition and relocation, drainage system maintenance, and retrofitting existing buildings.
- **Warning and Response.** These activities focus on emergency warnings and response in order to save lives and minimize property damage. Examples include flood threat recognition systems, critical facilities planning, levee or dam failure warning systems, and response operations planning.

Implementation

The Colorado Water Conservation Board (CWCB) maintains a comprehensive web resource for communities interested in participating in the CRS program. The website includes information for communities that are new to CRS; program pre-requisites; a description of CRS-eligible activities; a calculator for determining CRS points; on Community Assistance Visits (CAVs); and information about maintaining CRS status. The portal also includes a map of all participating communities in Colorado and their current CRS rating.

Where It's Been Done

The **City of Delta** recognized that the benefits of CRS extend beyond flood insurance premium discounts. Despite having less than 20 NFIP policyholders in the entire community, the City has actively participated in the program since 1996 and is currently rated as CRS Class 8. Delta receives credit points for a number of ongoing and routine municipal activities, including significant points for open space preservation and drainage system maintenance. The City also gets credit for public outreach activities administered by its Community Development Department, such as annual mailings to local realtors and insurance companies about floodplain management, hazard disclosure, and its participation in CRS. The City has also promoted the advantages of purchasing flood insurance at public meetings, presentations to community groups, and through local newspaper articles.

The **Pikes Peak Regional Building Department (RBD)** is an example of how a county or regional authority can help administer CRS-creditable activities for multiple jurisdictions across a region. Under an inter-governmental agreement, the Pikes Peak RBD serves El Paso County; the cities of Colorado Springs, Fountain, and Manitou Springs; and the towns of Green Mountain Falls, Monument, and Palmer Lake. Although primarily tasked with the enforcement of building codes, the RBD's Floodplain Management Office provides services to

all communities, including but not limited to: enforcing regulations, reviewing site plans, issuing floodplain development permits, maintaining local floodplain maps, investigating and resolving floodplain violations, performing flood mitigation evaluations, and other activities for credit under CRS. Through its efforts, the RBD has assisted the City of Colorado Springs in becoming a CRS Class 5 community and all other jurisdictions to become CRS Class 7 communities, demonstrating how **regional collaboration on CRS can increase potential credit points while also reducing some of the local administrative burdens associated with the program.**

Some argue that a similar concept to the Community Rating System should be developed for wildfire mitigation activities. The program could benefit communities that implement wildfire mitigation measures by offering incentives such as preferred forest management and fuel treatment, community planning assistance, or higher ranking for access to competitive grant programs (*Lessons for Wildfire*, 2014). **Summit County** has explored using the CRS concept to reduce wildfire hazards. The goal is to combine multiple approaches, including implementation of Firewise Community development guidelines, development code/zoning ordinance integration with wildfire hazard reduction planning, and community action, such as efforts by the Summit County Wildfire Council to provide free chipping and grants for improving firefighting infrastructure (cisterns, improved emergency access, fuels reduction programs, etc.). It is anticipated that through these efforts the community's wildfire hazard rating could be lowered, resulting in potentially lower insurance rates (*National Flood Insurance*, 2015).

Advantages and Key Talking Points

The primary benefit and motivation for communities to participate in CRS is the reduction in flood insurance premiums for resident policyholders. Other benefits include:

- Enhanced life safety and reduction in damage to property and public infrastructure, avoidance of economic disruption and losses, reduction in human suffering, and protection of the environment provided by the credited activities.
- Access to training, technical assistance, and other resources made available to CRS communities.
- Ability to evaluate local programs and activities against state and nationally recognized benchmarks.
- Recognition for strong local floodplain management programs.
- The program is not all about creating new activities or policies. Communities can often obtain credit points for activities and policies they are already implementing.
- There is no cost to participate. The only costs the community incurs are to implement creditable floodplain management activities and the staff time needed to document those activities and prepare for and participate in the recertification process and verification visits.

Challenges

The most significant challenge for communities is the administration of the program. Each community must designate a local representative to oversee the development, implementation, and documentation of activities for which they are seeking credit. Documenting requirements for credit verification can be time-consuming depending on existing recordkeeping practices. Other challenges include:

- A modification to a community's CRS classification requires additional submittal materials, and is limited to one modification per year.
- Prerequisites for advanced classes can become a road block.
- With staff turnover, the program can be difficult to administer.

Key Facts

Administrative capacity	Experienced planner; floodplain manager
Mapping	Depends on chosen activities
Regulatory requirements	N/A
Maintenance	Annual review required by FEMA to maintain credit rating
Adoption required	No
Statutory reference	N/A
Associated costs	Staff time, training and reporting

Examples

Delta County Multi-Hazard Mitigation Plan	http://www.deltacounty.com/DocumentCenter/View/815/Multi-Hazard-Mitigation-Plan?bidId=
City of Fort Collins Utilities, Class 2 – 40% discount	fcgov.com/utilities/what-we-do/stormwater/flooding/insurance
City of Gunnison Building Department, Class 7 – 15% discount	http://www.cityofgunnison-co.gov/departments/building/index.php
Town of Parker Class 5 – 25% discount	parkeronline.org/353/Floodplain-Management-Program
Pikes Peak Regional Building Department Regional Floodplain Management	https://www.pprbd.org/Download/Floodplain#FloodplainJump

For More Information

FEMA's CRS Website
fema.gov/national-flood-insurance-program-community-rating-system

Floodsmart.gov
https://www.floodsmart.gov/

CRS Resources
crsresources.org

Lessons for Wildfire from Federal Flood Risk Management Programs
headwaterseconomics.org/wildfire/solutions/lessons-for-fire-from-floodrisk

Colorado Water Conservation Board (CWCB) Community Rating System
http://coloradohazardmapping.com/crs#!/home

Density Bonus

Hazards Addressed

How it Works

Density bonuses allow greater density to be built on a site than would otherwise be allowed through underlying zoning. Density bonuses are often granted as an incentive to encourage preferred types of development activity. Some communities grant density bonuses for additional protection of open space, for example, beyond what is required by the underlying zoning, or for higher-quality building design or provision of other amenities. While the exact bonus granted is typically considered on a case-by-case basis, the amount of additional density granted is usually roughly proportional to the amount of benefit provided. Any additional density allowed can be subject to design standards that ensure a high level of site protection and building quality; such standards can help promote community buy-in for the bonus program.

Implementation

Density bonuses can be somewhat challenging to introduce in a community. Depending on why a density bonus is issued, it is important to have a process by which the local government can ensure that both ends of the bargain are maintained. For example, if a developer is issued a density bonus for conserving land in a geologic hazard area, the local government should require a permanent **conservation easement** to protect that area in perpetuity in exchange for the added density. (Conservation easements are profiled in the "*Protecting Sensitive Areas*" section.)

The community should consider the following basic steps:

- **Define the purpose of the program.** It is important that density bonuses be tied to the goals and policies of a community's comprehensive plan.

- **Identify where density bonuses are permitted.** Consider whether the incentives should apply to all zoning districts, only areas meeting certain conditions, or on a case-by-case basis.
- **Develop the specifics of the program.** Identify the degree to which incentives are issued, whether they are permitted by right or require a public hearing, and other conditions or agreements that must accompany the program.

Where It's Been Done

Density bonuses are often used in tandem with conservation subdivisions, which are addressed in a separate profile. **Garfield County** provides density bonuses for conservation subdivisions in Section 7-501 of the Land Development Code. The applicant may propose a density neutral development plan, by which the overall density is not increased, but the lot sizes may be reduced to preserve the remainder of the parcel as open space. The applicant may also propose an increased density development plan, by which the calculation of total bonus lots permitted depends on the total expected yield allowed under the base zoning district and the proposed percentage of open space preserved.

The **Town of Milliken** issues conservation density bonuses for rural subdivisions that conserve areas in the 100-year floodplain, wetlands, valuable habitat areas, and natural geologic hazard areas (as defined by the Colorado Geological Survey). Rural subdivisions are permitted development up to a maximum of one unit per 20 acres by right. A conservation density bonus increases that maximum density to one unit per five acres.

Advantages and Key Talking Points

Density bonuses can be effective ways to not only protect hazard areas, but also to direct growth toward desirable areas throughout a community as identified in the comprehensive plan. Other benefits include:

- Increased opportunity for developers to boost their bottom line. By purchasing development rights, a developer can increase the number of units and realize a higher profit.
- Increased density where the community wants it. Densifying receiving areas can result in a more diverse housing stock, can help boost surrounding commercial areas, and could potentially result in development of affordable housing units not otherwise feasible without the added density bonus.
- Density bonuses provide a direct incentive to a developer without requiring complex negotiations often associated with Transfer of Development Rights (TDRs).
- Density bonuses can be calibrated to be either by-right or discretionary, depending on community values and political climate.
- Density bonuses provide a community benefit without requiring public funding.

Challenges

Challenges include the following:

- Requires additional maintenance to determine that the exchange of density is met with the agreed conservation in perpetuity.
- Like TDRs, density bonuses must be calibrated to local market demands, or the program might not be used.
- Requires education to inform the public about appropriate trade-offs for increased density in some areas.

Key Facts

Administrative capacity	Experienced planner with city or county attorney to write ordinance; skilled planners to administer
Mapping	Not typically, although maps indicating sensitive or hazardous lands may be required as part of the development application process
Regulatory requirements	Land use and subdivision regulations
Maintenance	Some on-going tracking with explicit documentation of density bonuses is required
Adoption required	Yes
Statutory reference	N/A
Associated costs	Ordinance development or amendment costs and staff time to review density bonus applications

Examples

Garfield County Land Use and Development Code	https://www.garfield-county.com/community-development/documents/land-use-code/Complete-Land-Use-Code-2017.pdf Section: 7-501
Town of Milliken Land Use Code and Subdivision Regulations, Conservation Density Bonuses	https://library.municode.com/co/milliken/codes/municipal_code?nodeId=CH16LAUSCO_ARTIVSURE_DIV3RUSU_S16-4-270CODEBO Section: 16-4-270 Conservation Density Bonus

Model Code Language and Commentary

A community can implement a density bonus program in several ways. In its simplest form, a density bonus program might authorize the transfer of development density from one part of a site to another, to avoid development in hazard-prone sites or other sensitive areas. Often, however, density bonus programs involve a more rigorous process that includes formal protections, such as dedicated conservation easements, to protect sensitive areas. In all cases, communities should tailor the program to cater to the unique market conditions of the area, staff capabilities and resources, political climate, and the goals and objectives of the comprehensive plan.

Density bonus programs are usually coupled with other planning tools and strategies described in this guide, such as cluster subdivisions, conservations easements, transfer of development rights, development agreements, overlay zones, and stream buffers and setbacks.

Regardless of whether a density bonus program stands alone or is integrated with other planning tools, some basic elements are common in most approaches:

- Purpose
- Applicability
- General Standards
- Determination of Density Bonus
- Incentives and Benefits
- Ownership and Maintenance
- Definitions

The following sections provide model language for each of the common elements. Model language is in blue shading. Commentary is located in italics in the column at the right. The model language used in this document is based on existing ordinances from communities around the state and nation.

Commentary

Customizing Your Approach: *There are several options for introducing a density bonus program into a community; this guide offers a few of the many implementation tools a community could employ.*

Some communities have integrated density bonus standards into subdivision provisions or affordable housing standards. A community may also adopt a density bonus overlay zone. Each community should evaluate the most effective and efficient way to implement this tool based on their current policies and practices.

The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose

The purpose of the density bonus program is to help implement the goals and objectives of the community's comprehensive plan and to:

1. Protect public and private property from natural hazards by avoiding development in natural hazard areas including but not limited to floods, geologic hazards, wildfire and avalanche;
2. Preserve and protect environmentally sensitive lands or land with development constraints;
3. Assist in the orderly development of urban and rural lands;
4. Encourage new development in areas with adequate existing infrastructure and services;
5. Preserve areas with productive soils for continued agricultural and forestry use by preserving blocks of land large enough to allow for efficient operations;
6. Provide greater efficiency in the siting of services and infrastructure by reducing road length, utility runs, and the amount of paving for development; and

Purpose: *The purpose statement is the jurisdiction's opportunity to describe the intent and benefits of the density bonus standards. Typically, the primary purpose of a density bonus is to incentivize developers to increase the maximum allowable development on a property in exchange for avoiding development in hazard areas, and/or preserving natural areas, open space, or farmland. The purpose statement(s) should be tailored depending on the community's top priorities.*

7. Provide an opportunity for landowners to obtain a higher return on investment through increased density in exchange for conserving sensitive lands.

Applicability

1. The density bonus regulations are applicable when the zone in which a project is located specifically authorizes residential densities exceeding the base density of the zone.
2. Additional density shall be approved as part of the required permit process for the type of development proposed and shall comply with all other applicable requirements of the zone district unless otherwise stated in this Chapter.

Applicability: *A density bonus system should be developed and used within the context and guidance of a community's comprehensive plan and/or growth management strategies.*

Density bonus provisions should be integrated into the portions of the code specifically related to density minimums and/or maximums. For example, a table might show a base allowed maximum density for a particular zoning district, along with a higher maximum density that may be achieved through a bonus program.

General Standards

Eligibility: Developers shall satisfy the following provisions to be eligible for a density bonus.

1. A minimum of [*insert minimum acres or percentage of lot area*] of the property shall be within a natural hazard area as designated on the "Official Hazards Map."
2. A minimum of [*insert minimum acres or percentage of lot area*] of the property shall be preserved as undeveloped/natural/open space and shall be protected by a permanent conservation easement.

1. **Submittal:** Density bonus requests shall be submitted to [*staff person or department*] and shall be accompanied by plans, exhibits, a project description, and other information as required by [*staff person or department*], to sufficiently demonstrate compliance with the provisions of this Chapter.
2. **Declaration of Restriction of Development and Easement:** The owner shall execute an easement in perpetuity restricting development in accordance with the requirements of this section and in a form acceptable to the Planning Department, approved by the [*insert name of local government*] Attorney and signed by the owner of record. Such easement shall be recorded in the Clerk's Office prior to approval of any eligible development application.
3. **Official Hazards Map:** The areas designated as having potential for natural hazards are depicted on a map designated as the [*insert name of hazards map, e.g. "Official Hazards Map"*]. The [*insert name of map*] shall be included as part of this ordinance by reference and shall be kept on

General Standards: *A density bonus system should be administered with flexibility, as much predictability as possible, and with minimal delays. The approval process for developments with density arrangements should not require more time, effort, and cost than for conventional developments. The process should be more streamlined; there must be real incentives to adopt it.*

Eligibility: *The community's Official Hazards Map should inform the threshold for determining if a parcel/lot is eligible for the density bonus. If there are several properties with small areas of natural hazard potential, the community will need to determine an appropriate minimum threshold.*

Declaration of Restriction of Development and Easement: *Recording deed restrictions on a property may not always be necessary; this is one approach used by communities to ensure protected land remains undeveloped. For more information about this approach, refer to the Conservation Easement section of this guide.*

Official Hazards Map: *The official hazards map may be one comprehensive map with various hazard risks identified, or could be a series of maps to address specific risks.*

file in the [*insert name of department*] and available for public inspection. The [*insert approval authority-e.g., City Council, Planning Commission, or Planning Director*] may amend these maps from time-to-time to reflect changes in hazard risk.

4. **Comprehensive Plan:** Density bonus requests shall be consistent with the comprehensive plan and with natural hazard areas designated on the [*insert name of map*].
5. **Other Requirements:** Prior to final approval, the [*insert name of local government*] may require a Development Agreement and/or other binding agreement as necessary to ensure compliance with this Chapter and other [*city/county*] requirements.
6. **Terms:** Except as provided under Subsection F (other requirements), a density bonus approval shall be binding on the subject property and shall run with the land.
7. **Approval Authority:** The [*insert approval authority*] may approve, deny, or approve with conditions, density bonus applications filed in accordance with this Chapter.

Determination of Density Bonus

Each community should consider the local market demands, staff capacity, and political climate to establish a tailored density bonus program that maximizes the protection of natural hazard areas; there is no right or wrong approach. Local governments may use one or a combination of two fundamental approaches to density bonuses: formula-based and case-by-case negotiation. Both have merits and limitations. Two examples of code language and a brief narrative for each are provided below.

Non-Residential Alternatives: *While "density" is not a common metric for non-residential projects; a community may elect to relax building bulk and site design standards to incentivize developers who elect to preserve natural hazard areas. For example, in exchange for preserving a natural hazard area a commercial project may have relaxed parking standards, greater floor area or lot coverage for less sensitive portions of the lot, or be allowed to increase overall building height.*

A density bonus application for non-residential projects should be carefully considered to determine local market conditions as well as context-sensitive design. Infrastructure capacity and desired character of development areas should also be considered.

Option 1: Formula-Based Approach

The formula-based approach involves setting forth a clear, consistent methodology in the code for how a developer may obtain a density bonus. The same formula and standards apply to all properties, which offers predictability (but may limit the community's ability to adapt the standards to unique circumstances).

EXAMPLE:

A developer is requesting to develop a 50-acre parcel, 20 acres of which is not developable (lake, stream, steep slope, open space requirement). This leaves 30 acres of net buildable area. The current zoning allows for three units per acre, which would allow up to 90 lots on this parcel (this is the base density).

The developer is preserving 10 acres of natural hazard area (33.33 percent of the net buildable area); therefore he/she is eligible to increase the base density by 40 percent pursuant to the table above. This brings the total unit count to 120, with a total project density of four units per acre. This example increases the project density by one unit per acre above what the underlying zone would allow.

Summary of Calculation:

Total Parcel Area:	50 acres total
Undevelopable	(-)
Lake Area:	4 acres
Stream Area:	1 acre
Steep Slope Area:	5 acres
Open Space Requirement:	10 acres
Net Buildable Area:	30 acres
Zoning: Residential-3	3 units/acre
Base Density:	90 units
Natural Hazard Area Protected:	10 acres (33.33 percent)
Density Bonus:	40 percent
Bonus Units:	30 units
Total Units (base + bonus):	120 total units
Final Project Density:	4 units/acre (120 units/30 acres)

Option 2: Case-by-Case Negotiation

Some communities may elect to administer a density bonus program on a case-by-case basis to provide more flexibility. This approach allows the developer and local government to negotiate the terms and conditions of the agreement specific to each project. While this approach offers unlimited flexibility and the ability to tailor density bonuses to each site, it also means less upfront certainty and could involve a prolonged development approval process, which can increase costs and potentially inhibit development.

This approach typically requires the execution of a development agreement, a legally binding contract between a property owner or developer and a local government, often including terms not

Formula-Based Approach: *A formula-based density bonus can be calculated using fixed and known variables (i.e., unit area) or it can be calculated using a point-based system (i.e., increased benefit for incorporating specific design elements).*

The Town of Milliken, Colorado, issues density bonuses for rural subdivisions that preserve floodplains, geologic hazard areas, and other natural areas by adjusting the maximum density from one unit per 20 acres to one unit per five acres. Milliken Land Use Code.

The City of Fruita, Colorado, has implemented a point-based approach: Fruita Land Use Code.

Variables unique to each community should be considered when determining the appropriate incentives for developers. In the end, it is critical that the incentive is equal to or greater than the value that would otherwise be lost if the natural hazard area were not protected; otherwise the tool may not be used.

Example: *The developer could further maximize return on investment by incorporating Cluster Subdivision design principles into the development.*

Note: This example does not take into account required access, drainage, or other site elements which may impact the final lot count.

otherwise required through existing regulations. This link will direct you to model language for development agreements: Development Agreements.
The [*insert approval authority*] is authorized to grant density bonuses in accordance with the following provisions:

1. Units of density are dwelling units per gross lot area.
2. When calculating the number of density bonus units, any calculations resulting in fractional units shall be rounded up to the next larger whole number.

If a developer elects to preserve natural hazard areas as designated on the "Official Hazards Map," density bonus may be authorized according to the following calculation:

Minimum Natural Hazard Area Protected (% of net buildable area)	Maximum Density Bonus (% increase from base density)
5 – 9.99%	10%
10 – 14.99%	20%
15 – 19.99%	25%
20 – 29.99%	30%
30 – 49.99%	40%
50% or greater	45%

Case-by-Case Negotiation: *Strive for transparency and consistency, especially where a density bonus is negotiated by terms of a development agreement, so that a local government can demonstrate it is following due process and diligence, acting in good faith, and without discrimination. This is facilitated when a local government's actions and intentions are supported by strong policy.*

The City of Longmont, Colorado, offers density bonuses in exchange for various community benefits such as alleys and dedications of greenways. Such bonuses have maximum caps, but are at the discretion of the decision-making body on a case-by-case basis. Longmont Land Development Code.

Incentives and Benefits

A. Development Standards: For development projects requesting a density bonus, the [*insert approval authority*] may grant up to a [*10-40 percent*] modification of one or more the following standards to further maximize the protection of natural hazard areas:

1. Reduced minimum lot sizes and/or dimensions;
2. Reduced minimum lot setbacks;
3. Increased maximum lot coverage;
4. Increased maximum building height and/or stories;
5. Reduced on-site parking standards, including the number or size of spaces and garage requirements;
6. Reduced minimum building separation requirements; and/or
7. Reduced street standards, e.g., reduced minimum street widths.

B. Other Incentives:

1. Expedited review;
2. Reduced development, impact, and permit fees; and
3. Other incentives or concessions, proposed by the developer or [*name of local government*], that result in increased protection of natural hazard areas.

Incentives and Benefits: *Density bonus programs offer advantages over base zoning for developers; however, local governments may provide additional incentives to promote use of the program. For example, in exchange for preserving hazard-prone areas, a community may relax development standards so developers are able to achieve the same or higher density by using smaller, more flexible lot sizes and relaxed setback requirements.*

Minimize Negotiation: *If a community elects to relax development standards to further incentivize the density bonus program, the development code should clearly state what is acceptable. This will ensure fair treatment and minimize time spent negotiating terms. Modification standards should be context-sensitive and reflect the values of the community.*

Other Incentives: *Reduced development, impact, or permit fees associated with a density bonus program should be clearly stated in the community's adopted fee schedule.*

Ownership and Maintenance

Ownership: Ownership of protected hazard-prone areas may be handled through one or more of the following:

1. A homeowner's association where specific development restrictions and maintenance requirements are included as part of its bylaws;

2. Fee simple dedication to the County, another unit of local government, the State of Colorado, or a private nonprofit land conservancy; and/or

3. The developer and/or private landowner.

Maintenance: Natural features shall be maintained in their natural condition, but may be modified to improve their appearance, functioning, or overall condition, as recommended by professional best practices. Permitted modifications may include:

1. Reforestation;

2. Pasture or cropland management;

3. Buffer area landscaping;

4. Stream bank protection;

5. Wetlands management; and/or

6. Other modifications approved by [*insert approval authority*].

Financial Responsibility: Unless accepted for dedication or otherwise agreed to by the County, another unit of local

Long-Term Land Management: *The long-term management of protected areas can be a challenge for communities, especially if those areas have an increased risk for natural hazards. Lands placed in a conservation easement can be owned and maintained by a private owner, a homeowners association, a land trust, or conveyed to the local government or other public entity.*

Where density bonuses are applied to previously subdivided land, development restrictions and maintenance provisions within the bylaws of a homeowners association or other external entity would require amendment by separate mechanism outside the local government's land use regulations.

government, the State of Colorado or a private non-profit land conservancy, the cost and responsibility of maintaining protected property and any facilities located thereon shall be borne by the property owner and/or homeowners association.

Conservation Area Management Plan: A conservation area management plan that defines the roles and responsibilities for managing protected land shall accompany and be approved as part of the final development approval.

Definitions

Undevelopable Land: *Communities may or may not include a definition of "undevelopable land" in their regulations. Density bonus programs should be customized to offer bonuses for protecting hazard-prone areas not already prohibited from development through some other mechanism.*

Density Bonus: The overall number of dwelling units above and beyond the maximum allowable density located on the net buildable area within the development and calculated on a per-acre basis.

Net Buildable Area: The area calculated by subtracting the total area of undevelopable land from the total parcel or lot area.

Undevelopable Land: Property that cannot be developed with site improvements due to the size, shape, frontage, topography, location, and/or legal use. Undevelopable land includes, but is not limited to:

- Dedicated right-of-way;
- Easements or other deed restrictions prohibiting the construction of improvement on the property;
- Any land dedicated to the City for parks or greenways;
- Areas with slopes of [*insert steep slope percentage – e.g., 25 percent*] or greater;
- Areas within the 100-year floodplain [*or floodway, depending on local policy*]; and
- Any other areas determined by the [*insert approval authority*] to be undevelopable according to the "Official Hazards Map."

Official Hazards Map: The official map that identifies and delineates boundaries of areas that are affected by or vulnerable to a particular natural hazard.

Conservation Area Management Plan: A plan developed for a conservation area that has been approved by the [*insert approval authority*] to guide the design, development, and maintenance of the conservation area.

Development Agreement

Hazards Addressed

How it Works

A development agreement is a legally binding contract between a property owner or developer and a local government, often including terms not otherwise required through existing regulations. These agreements can specify various elements of the development process ranging from phasing of a larger master-planned community, to tax-sharing for retail development, to critical infrastructure responsibilities. Development agreements are sometimes used in combination with a planned unit development (PUD) in the form of a binding PUD agreement that specifies the negotiated terms of the development, but the two tools may also be used independently.

For hazard mitigation purposes, development agreements can be used to guarantee that a proposed development reduces risk to hazards by requiring it meet certain use requirements, site development standards, conservation practices, or long-term maintenance provisions not already required by land development regulations. Development agreements can also be used as an incentive. For example, if a developer agrees to enter into an agreement to include defensible space elements in a large-scale development in the wildland-urban interface, the local government might offer reduced fees, expedited review, or even density bonuses in exchange.

Implementation

To establish a development agreement, the developer and the local government both work with legal counsel to develop and execute a contract that binds all parties. During the

negotiation of such an agreement, planning staff should work closely with their land use attorney, appointed and elected officials, and the public to answer the following:

- **What is the purpose of the development agreement?** Crafting the purpose and goals will solidify the reasons why a development agreement is necessary and helps facilitate a process where the expectations for both parties are clearly articulated. This step should also act as a screening process for whether the purpose of the development agreement is consistent with a comprehensive plan or other policies generated by the jurisdiction.
- **Are the benefits to the community balanced with those to the developer?** Along with the general purpose of the agreement, a justification of the benefits of the agreement to health, safety, and welfare of the community should be considered.
- **Will these requirements be consistent for similar developments?** In addition to site-specific development agreement requirements, jurisdictions may choose to require the same standards for planned developments with similar conditions. Examples include offering incentives for developers to maintain vegetation in riparian buffers or requiring major subdivision developments in wildland-urban interfaces to counter the costs of firefighting.
- **Who will be involved in the development agreement process?** Opportunities for public input and stakeholder feedback are often important components of an agreement, which can help limit any negative response from the community.
- **How will the agreement be maintained throughout the life of the agreement?** Local governments should describe the long-term costs and maintenance requirements for both the jurisdiction and the developer, as well as monitoring procedures and processes for amending agreement terms in the future.

Where It's Been Done

La Plata County entered into an agreement with the Electra Sporting Club in 2012 for expansion of their existing facilities. The club was seeking to expand its uses to include new driveways and new cabin sites. The county and the club chose to enter into an agreement for the future development of the site. Although there are many provisions of the agreement, one of them is a Wildfire Mitigation and Evacuation Plan (WMEP). The article states that on an annual basis, Electra will notify all of its members of the WMEP and make available to each member appropriate hazard mitigation resources and materials. It also requires new cabins and replacement cabins to use fire-resistant materials, reduce fuel load on the site

Historic Electra Sporting Club building.

Source: La Plata County

surrounding the structure, and to maintain vegetation consistent with the WMEP. The WMEP is included as an appendix to the agreement. It includes extensive rules for private owners within the club grounds dealing with, for example, techniques for maintaining defensible space around individual cabins.

A development agreement between **Eagle County** and the Fox Follow Planned Unit Development created in 2017 communicated a number of conditions for the PUD, including one for rockfall hazard mitigation along the southern border of the proposed development. The agreement was amended in 2018, but the hazard mitigation provision remained. The document stated that Fox Hollow would be required to follow specific recommendations provided by the Colorado Geological Survey to install a rockfall fence, an open space parcel, or a combination of mitigation interventions to address the hazard. Additionally, the plat was required to be updated with an advisory note that the land may be susceptible to subsidence and sinkholes in the future.

Advantages and Key Talking Points

Development agreements allow communities a degree of flexibility not otherwise available per existing regulations. Advantages include:

- Creation of a separate contract from the zoning code and other ordinances allows all parties to negotiate any aspects of the development. However, this can be just as much of a challenge as a benefit.
- Ability to tailor specific mitigation actions and tie them to conditions of approval, thereby securing the commitment.
- The agreement can prescribe periodic reviews for compliance. This is especially helpful for site development standards such as landscaping or parking.
- Allows developer to obtain “vested rights” protected from any changes to existing zoning or land use laws during the term of the agreement.

Challenges

Critics of development agreements claim that they circumvent traditional development review processes. Other challenges include:

- Requires trained land use or real-estate attorney to draft and implement.
- The public can perceive these as “back-door deals” with little to no opportunity for input.
- Difficult for planners to track over time.
- Amendments to development agreements can be time-intensive. Once both parties enter into the agreement, they are locked into those provisions unless they both agree to an amendment.

Model Code Language and Commentary

Development agreements are negotiated on a case-by-case basis. Because each development agreement is

Commentary

unique and based on a particular development site and/or project, such agreements vary widely in content and the specific terms negotiated. The agreement depends largely on specific site conditions and/or mitigation objectives sought.

Negotiating and Drafting Development Agreements: *Development agreements allow local governments to achieve greater community benefits not otherwise required by adopted regulations. The local government attorney(s) should be involved in direct negotiations and drafting the agreement.*

Many agreements contain the following basic elements at a minimum:

- **Recitals** – These function similar to a purpose statement. What is the intent of the development agreement? How are the parties authorized to enter into such agreement?
- **General Provisions** – This section describes the project and use of the property, definitions of key terms, process for amending or terminating the agreement, and the relationship of the agreement to other regulations.
- **Obligations** – This section outlines the specific terms of the agreement. For example, are there fiduciary responsibilities? Site maintenance obligations? The agreement should include both developer and local government responsibilities.
- **Exhibits or Attachments** – These typically include a legal description of the property, any specific costs related to the obligations in the agreement, and other necessary supporting documents.

The following sections describe each of these elements and provide standard language regarding hazard mitigation that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on existing ordinances from several communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

A development agreement is a legally-binding document, and should therefore be carefully reviewed and/or drafted by the local government's attorney.

Recitals

Below are some basic recitals that could be applicable to development agreements pertaining to hazard mitigation.

- WHEREAS, [*the developer*] seeks permission to [type of approval sought – e.g., subdivision, site development] the property as described on [*Exhibit A*].
- WHEREAS, the [*governing body*] seeks to protect the public health, safety, and welfare of the community.
- WHEREAS, the [*governing body*] seeks to implement policies from the [*comprehensive plan, local hazard mitigation plan, or other adopted policy*] regarding [*hazard mitigation, or similar*].
- WHEREAS, the mutual promises and obligations in this agreement are authorized by State law and the [*local government*] regulations.

Recitals: *Other recitals may be applicable to the agreement, depending on the history of the property, the application under review, suggestions by local attorney(s), and the obligations included in the agreement.*

General Provisions

This section of the agreement should describe the general terms of the agreement including:

A. Legal description of the property.
B. Definitions (e.g., "development" or "geologic hazard area").
C. Description of parties (local government, developer or applicant, etc.).
D. Process for amending, terminating, or extending the timeframe for the agreement.
E. Does the agreement prevail over other zoning and/or subdivision regulations where there is conflict?
F. Noticing requirements to comply with state and local laws.

General Provisions: *This section may or may not include additional sections for legal framework depending on the attorney and/or terms of the agreement. For example, the agreement may include interpretation, severability, remedies, no third-party beneficiary, and other paragraphs deemed necessary for an effective binding contract.*

Obligations or Terms of the Agreement

For the specific terms of the agreement, local governments should consider the following as they pertain to hazard mitigation:

A. **Geographic location.** Where are the terms of the agreement applicable? Do they apply to the entire property? A portion of the property?
B. **Applicability.** At what point do the terms of the agreement go into effect? Do they apply to new structures? Existing structures? Are they limited to a specific time period?
C. **Duration.** At what point in time do the terms of the agreement expire? Are the terms effective for three years? Until completion of the first phase of development? In perpetuity?
D. **Responsibility.** Which party is responsible for specific terms of the agreement? Does the developer bear the cost of all mitigation activities? Are there inspections of improvements by the local government? If so, how often, and are there penalties for noncompliance?
E. **Sensitive lands and/or hazard areas.** Specific hazard areas, such as seismic zones, the wildland-urban interface (WUI), geologic hazard areas, or floodways, can be specifically addressed in the agreement. Reference to hazard areas requires that some level of mapping exist or be performed. For developments in a mapped hazard area, the community may require avoiding development in those areas and/or require adequate mitigation techniques to reduce risk.
F. **Additional documentation.** To protect lives and property, a development agreement can require additional documentation be prepared and submitted prior to certain development activities. For example, an evacuation plan might be required for subdivision in the WUI, or a soils report for development in areas with subsidence.
G. **Procedures.** Just like procedures in a development code, a development agreement can establish specific procedures for permitting development within a defined area or time period.

Obligations or Terms of the Agreement: *This section does not have to be labeled "obligations." There might be several sections following the recitals that are dedicated to the individual terms of the agreement, such as "limitation on number of structures," or "long-term maintenance of landscaping." For the purposes of this model, we title the section "obligations" as a catch all for the terms of the agreement.*

H. Maintenance. Requiring mitigation activities as a condition for development approval can be effective for some time; however, including long-term maintenance provisions will ensure that effective mitigation is achieved for decades or longer. For example, a development agreement can require that defensible space required by the agreement be maintained and inspected annually, or that new structures in a development use fire-resistant building materials, or require the construction of safe-rooms (shelter against tornadoes and other wind events) for uses where large numbers of people congregate.

Maintenance: *Maintenance provisions can help achieve one of the greatest challenges in planning for hazard mitigation – addressing existing development. Addressing hazard mitigation for future development is easier – by avoiding hazard areas all together or imposing stricter standards on development within known hazard areas. But strengthening already approved developments through long-term maintenance provisions helps communities be more resilient to future hazard events.*

Key Facts

Administrative capacity	Experienced planners; land use or real estate attorney
Mapping	Depends on terms of agreement
Regulatory requirements	N/A
Maintenance	Yes, requires maintenance and enforcement of agreed terms
Adoption required	No adoption required, but formal agreement between local government and developer
Statutory reference	Colorado's Vested Property Rights Act (C.R.S. § 24-68-101, et. seq.)
Associated costs	Potentially high costs for attorneys and analysis of issues to address in agreement

Examples

La Plata County Agreement between the county and Electra Sporting Club	https://laplatacountyco.iqm2.com/Citizens/FileOpen.aspx?Type=15&ID=1561&Inline=True
Town of New Castle Agreement between the Town and the Lakota Canyon Ranch for wildfire mitigation plan	newcastlecolorado.org/wp-content/uploads/2014/03/Lakota-Canyon-Ranch-Annexation-Agreement-copy.pdf (p.8 of 14)

City of Black Diamond, WA Agreement between the city and BD Village Partners, L.P.	ci.blackdiamond.wa.us/Depts/CommDev/planning/MPDDevAgreements/June2011/TV/Villages%20MPD%20DA%20v4%20June%202011.pdf
Eagle County Covenants controlling wildfire mitigation regulations for the Cordillera property owner's association	http://www.erfpd.org/assets/_orsd/p/49/cordillera-cwpp-update-2014-small.pdf Not a development agreement, but a good example of how to achieve a similar result through private controls

Transfer of Development Rights (TDRs)

Hazards Addressed

How it Works

A **transfer of development rights (TDR)** program allows additional density where the community wants to grow in exchange for preservation of sensitive areas that the community wants to protect from future development. This tool requires an adopted plan that clearly identifies areas the community desires to preserve or protect from development ("sending areas") and areas where growth and development are encouraged ("receiving areas"). A potential developer who owns property in a receiving area may purchase development rights (either from a TDR bank or directly from a property owner in the sending area) to boost her overall development potential; that additional potential could come in the form of additional buildings, additional height, additional density, or some other form established by the jurisdiction. Similarly, a property owner in a sending area may have limited building potential, but can realize a financial return by selling their development rights to an owner in a receiving area. TDRs have been used successfully in Colorado for decades to protect environmental resources, agricultural land, historic areas, and areas susceptible to natural hazards, such as steep slopes and floodplains, which often are identified as sending areas.

A closely related concept is a **purchase of development rights program (PDR),** in which development rights are acquired from an owner of property in an area that the community has identified as appropriate for protection and less development intensity. The rights are extinguished rather than transferred, thus lowering the number of potential developable sites both in the protected area and in the jurisdiction overall. In exchange for selling her development rights, the landowner grants a conservation easement on the property,

permanently protecting the land from development. The land may be sold or transferred, but the deed restriction remains in place.

Implementation

While simple in concept, creation and administration of a TDR program can be complex. Adopting a TDR program involves designating sending and receiving areas, as well as establishing values and allocation rates for development rights. For the program to work, developers must realize value (extra profit) beyond the cost of the additional development rights. Additionally, landowners in sending areas must feel that they are adequately compensated for giving up the right to develop. For example, a TDR program may sell development rights at a rate of $10,000 per TDR, yet the added density would increase the value of the property or development by only $13,000; the $3,000 extra profit might not be enough incentive to promote the use of the program. Planners should consult with valuation experts to determine the appropriate rates and allocations to ensure that transactions will occur.

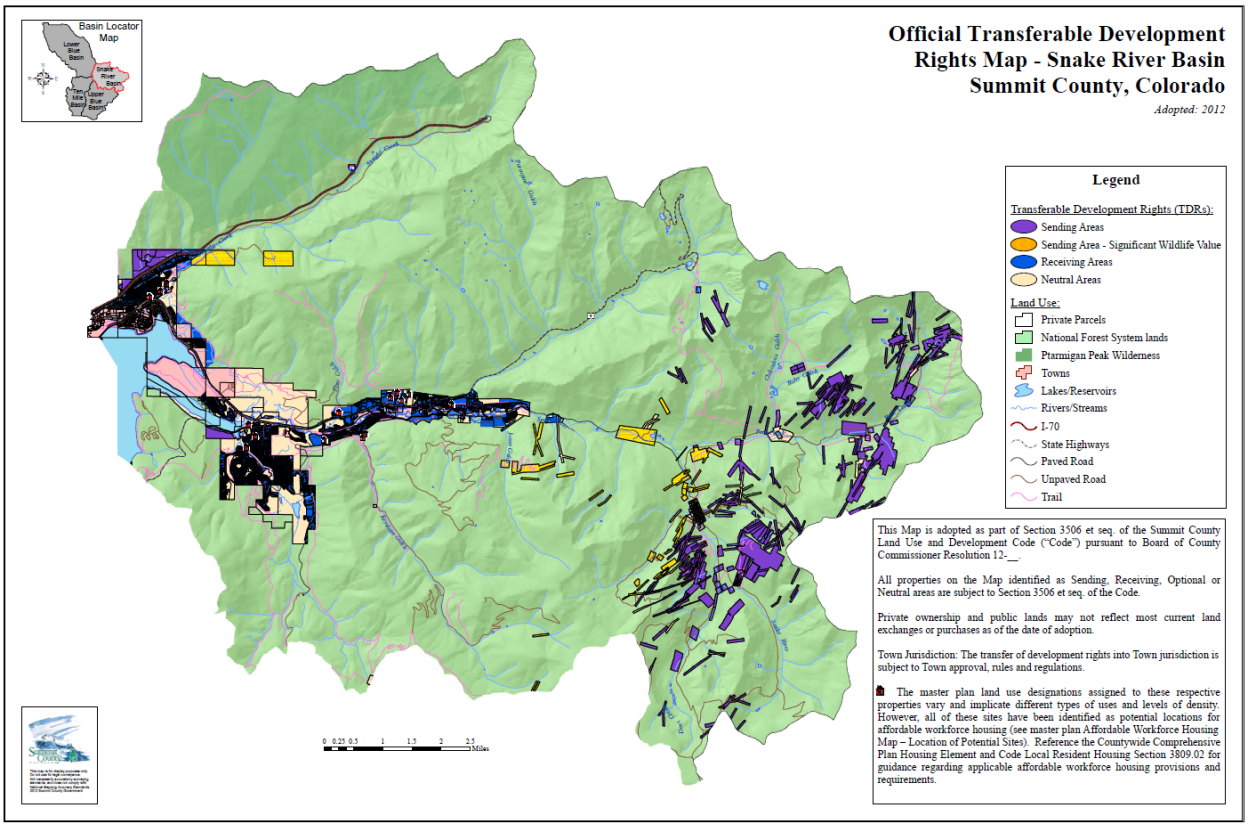
The community should follow the following basic steps:

- **Define the purpose of the program.** It is important that TDRs be tied to the goals and policies of a community's comprehensive plan and its hazard risk reduction priorities.
- **Identify where the TDRs are permitted.** Consider whether the incentives should apply to all zoning districts, only areas meeting certain conditions, or on a case-by-case basis. Identify specific sending areas and receiving areas.
- **Determine valuation and costs.** Establish values and allocation rates for development rights. This could be done by researching existing programs in comparable jurisdictions, or conducing new research with landowners and economists.
- **Establish procedures and institutions to administer the program.** Communities must decide whether to work with an existing financial institution or develop their own internal systems and procedures to promote the program, bank development credits, and handle transactions.
- **Develop the specifics of the program.** Identify the degree to which incentives are issued, whether they are permitted by right or require a public hearing, and other conditions or agreements that must accompany the program.
- **Adopt the ordinance.** Draft and adopt an ordinance formally establishing the TDR program and covering basic information such as the program purpose, applicability, and other specifics addressed in the sample model language below. Ensure consistency with other land use regulations.

Where It's Been Done

Summit County has a robust TDR program that protects environmentally sensitive areas from development. The program is divided into four geographically specific TDR areas, generally protecting rural backcountry parcels (sending areas) in exchange for more

development in the urban (receiving) areas. Summit County's program also includes "neutral areas" and "optional areas." Neutral areas are parcels that are not suitable for either sending or receiving development rights, and are not eligible for sending or receiving density. Optional areas include parcels that are determined to be suitable for either sending or receiving density. Summit County recently explored options for directly addressing natural hazards, in particular wildfire, through the TDR program. Those discussions were still underway at the time of drafting this guide.



The official TDR Map for the Snake River Basin in Summit County. Sending areas are in purple and orange – receiving areas are in blue.

Source: co.summit.co.us/DocumentCenter/Home/View/182

Routt County established a Purchase of Development Rights (PDR) Program in November 1996 and reauthorized the program in 2005 with increased funding through 2025. The program is intended to provide landowners a financially viable alternative to selling land for development by compensating them for the development rights on their land. Agricultural lands and natural areas (including wildlife habitat and riparian areas) have been the focus of the preservation efforts. An Advisory Board assists the County Commissioners in administering the program and selecting sites for acquisition (*Routt County PDR,* 2015).

Advantages and Key Talking Points

TDR programs can be effective ways to not only reduce development in hazard areas, but also direct growth to the desirable areas throughout a community. Other benefits include:

- Increased opportunity for developers to boost their bottom line. By purchasing development rights, a developer can increase the number of units and realize a higher profit.
- Increased density where the community wants it. Densifying receiving areas can result in a more diverse housing stock, can help boost surrounding commercial areas, and could potentially result in development of affordable housing units not otherwise feasible without the added density bonus.

Challenges

Administering a successful TDR program is not as simple as protecting one area and increasing the density elsewhere by means of a transaction. TDR programs are often highly political and can be difficult to both map and maintain over time. Other challenges include the following:

- Receiving areas can be potentially contentious. It might look good on paper, and the comprehensive plan might even state that additional density is appropriate in the vicinity; but officially designating an area as a receiving area can elicit mixed emotions related to density.
- Conversely to the receiving areas, designation of sending areas can be perceived as stripping a landowner's right to develop and can result in legal challenges and lengthy negotiations.
- Values of a development right must be calculated and recalibrated to respond to market conditions.
- Not all sending or receiving areas are created equal. In larger counties or municipalities, the perceived values of TDRs could vary in different locations. For example, a sending area that is surrounded by encroaching development might be the basis for argument that the value of developing that land is greater than another less desirable sending area. These nuances can be addressed by adjusting allocations, but only add to the complexity of the program.
- A TDR program can be complex to administer without adequate staff training and education. Planners must strike a balance between a simplified approach that is easy to understand, yet responsive enough to development realities to act as an effective incentive.
- Intergovernmental agreements (IGAs) are needed to effectively implement a TDR program if multiple jurisdictions are involved. In Summit County, the TDR program within the Upper Blue Basin has been very effective due in large part to an IGA between the County and the Town of Breckenridge where many of the receiving areas are located.

Model Code Language and Commentary

A TDR program should be tailored to the needs of the individual community and reflect local planning goals. Key features found in TDR programs include:

- Purpose
- Applicability
- Designation of Sending and Receiving Areas
- Determination and Allocation of Development Rights
- Requirements for Sending and Receiving Sites
- Program Monitoring
- TDR Bank (optional)

The following sections provide example language for each of the common elements. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on existing ordinances from several communities around the state with effective TDR programs, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Commentary

Local Examples: *In Colorado, two of the more longstanding TDR programs are in Boulder County and Summit County. See "Where It's Been Done" above for more detail.*

Purpose

The purpose of the transfer of development rights program is to help implement the goals and objectives of the community's comprehensive plan and to:

A. Preserve and protect environmentally sensitive lands or land with development constraints;
B. Protect public and private property from natural hazards, including but not limited to floods, geologic hazards, and wildfire;
C. Assist in the orderly development of urban and rural lands;
D. Encourage new development in areas with adequate existing infrastructure and services;

Purpose: *TDR programs are typically designed to address multiple goals. Typically TDR programs strive to preserve open space and environmental features in exchange for allowing more development in areas with planned or existing infrastructure and services capable of accommodating additional growth and development. The list of purposes may be tailored to the community's planning goals or may include a broad range of purposes to allow expansion of the program based on adjustments to planning goals.*

E. Provide a mechanism for willing landowners in sending areas to protect environmentally sensitive lands and land with development constraints and make reasonable use of their property rights by transferring some or all of their development rights to receiving areas; and

F. Provide an opportunity for landowners in receiving areas to obtain a higher return on investment through development at an increased density through the purchase of development rights from sending areas; and

G. Establish a system whereby development rights may be reliably transferred.

Applicability

A. The TDR program regulations are applicable only in designated sending and receiving areas as described in this ordinance.

B. The applicable provisions of this section shall be met by any development project, receiving site, or sending site that seeks to utilize the TDR program.

C. Additional density (in residential receiving areas) or square footage (in commercial receiving areas) must be approved as part of the required permit process for the type of development proposed and shall comply with all other applicable requirements of the zone district of the receiving area.

Applicability: *The purchase of a development right does not guarantee approval of a project. The TDR program establishes the units that will be traded, which in residential areas might be dwelling units, but in nonresidential areas, could be a range of things like square footage, height, or access to utilities.*

Designation of Sending Areas and Receiving Areas

A. Official Transferable Development Rights Map: The properties designated as Sending Areas and Receiving Areas are depicted on a map designated the "Official Transferable Development Rights Map." This map is included as part of this ordinance by reference and shall be kept on file in the Planning Department and available for public inspection. The [*approval body*] may amend these maps from time-to-time based on the criteria for designating Sending Areas and Receiving Areas.

Designation of Sending and Receiving Areas: *Some TDR programs use overlay zone districts to show TDR sending and receiving areas. Others establish specific zone districts as eligible sending areas or receiving areas and list them in the TDR section of the land development code. Whatever method is used, it is important to clearly define sending and receiving areas (or "optional areas," as used in Summit County).*

B. Comprehensive Plan: Sending and Receiving Areas designated on the Official Transferable Development Rights Map shall be consistent with the comprehensive plan.

Determination and Allocation of Development Rights

The transfer of development rights program establishes a framework to match landowners that are eligible to transfer (sell) development rights with land developers that desire to acquire (purchase) development rights as follows:

Determination and Allocation of Development Rights: *TDR programs need to gear the calculation of TDRs to the local market conditions, infrastructure capacity, and desired character for receiving areas. In some markets a TDR may need to be calculated at a higher "value" (e.g., one allowed residential unit in the sending area provides 1.5 residential units in a receiving area) to make TDRs desirable to developers. A local TDR program can also establish different density ratios for different Sending and Receiving Areas. A market study is critical to establish market demand in receiving areas and realistic TDR values.*

A. Calculation of Transferable Development Rights in Sending Area

1. Properties located in a residential zone district in a Sending Area: Each residential unit permitted by the existing zone district shall be considered one development right.
2. Properties located in a non-residential zone district in a Sending Area: Each [unit] of non-residential development shall be considered one development right.
3. A subdivision plat and/or site plan may be required to determine the number of dwelling units or amount of non-residential square footage that could be established on the property in the Sending Area.

Nonresidential: *For nonresidential properties, an appropriate unit must be established, such as 15,000 square feet.*

B. Allocation of Purchased Development Rights in Receiving Area

1. Development rights purchased from a Sending Area shall be used only in a designated Receiving Area.
2. Each purchased development right entitles a receiving site to increase the density allowed under the receiving site's zone district as follows:
   - **a.** [*One*] additional residential unit; or
   - **b.** [*Unit*] of non-residential space.

C. Uses Allowed: Only the uses allowed by the receiving site's existing zone district are allowed under the TDR program.

Sending Site Requirements

A. Separation of Development Rights: Transferable development rights (TDRs) may only be transferred from specified Sending Areas to specified Receiving Areas. A landowner in a Sending Area may voluntarily sell development rights to a buyer at a market value established by the landowner and the buyer. Prior to the time of the sale, a deed restriction shall be recorded with the County Clerk's Office limiting the future development potential of the Sending Site. A TDR Certificate shall then be issued by [*name of local government*] identifying the number of transferred development rights and the book and page numbers of the recorded Declaration of Restriction of Development and Easement.

Sending Site Easements: *The form of the easement should be tailored of the local community's goals and private landowner's needs. A standard easement agreement should be developed for ease of administration. The easement should detail what areas of the sending site are to be restricted from any future development to fully address natural hazard mitigation. The local government can work with local conservation agencies to accept an easement and take responsibility for working with sending site property owners to monitor the easement.*

B. Future Development of a Sending Site: Development of the unrestricted portion of the sending site shall comply with the standards of the sending site's zone district and is limited to the remaining development rights not extinguished through conversion to a TDR. No rezoning of the sending site to a higher density shall be permitted by [*name of local government*].

Restriction on Sending Site: *A crucial part of the overall tradeoff behind the TDR system is the restriction placed on the sending site, here accomplished through a prohibition on future rezoning to higher density.*

C. Transferable Development Right Certificate: A certificate specifying the number of development rights to be transferred is required to sell and transfer development rights. The [*Planning Director or designee*] shall be responsible for:

1. Determining the development rights that may be transferred from an eligible sending site;
2. Issuing a transfer of development rights certificate specifying the number of development rights being transferred in either dwelling units or square feet of non-residential floor area eligible for transfer; and
3. Calculating the number of remaining development rights on a sending site, if any.

D. Declaration of Restriction of Development and Easement: The owner of the sending site shall execute an easement in perpetuity restricting development in accordance with the requirements of this section and in a form acceptable to the Planning Department, approved by the [*name of local government*] Attorney and signed by the owner of record. Such easement shall be recorded in the Clerk's Office prior to issuance of a TDR certificate and approval of any development application on an eligible receiving site.

E. Recordation of Easement: Upon recordation of an easement restricting development based on issuance of a TDR Certificate, the number of development rights specified by the TDR Certificate shall be considered severed from the sending site and available for purchase and use on a receiving site or for purchase by a conservation organization and permanently retired or held for future purchase.

F. Use of TDRs Voluntary: An owner of record in a Sending Area choosing not to participate in the TDR Program shall retain the option to develop the property as provided by the property's existing zone district and applicable requirements of this code.

Mandatory TDR Programs: *Most TDR programs are voluntary, but a handful, such as the large Pinelands program in New Jersey, are mandatory.*

Receiving Site Requirements

A. Official Map: TDR Certificates proposed for use on a receiving site shall originate only from a Sending Area identified on the [*name of local government*] Official Transfer of Development Rights Map.

B. Pre-Application Meeting: Prior to making an application to purchase or use TDRs, an owner of record of a receiving site or their representative shall

Mapping Receiving Areas: *Mapping the receiving areas provides assurance to property owners and is often done, but not always. Boulder County, for example, does not map TDR receiving areas so as to influence land values and encourage speculation. Property owners are given flexibility to propose their land as a receiving site and show it meets the criteria for approval. Surrounding property owners and the public are given the chance to comment on proposed receiving areas.*

meet with [*name of local government agency*] to discuss:

1. Program requirements;
2. Availability of TDRs;
3. Potential density increase with the use of TDRs for the specific receiving site; and
4. Zoning and site development requirements for the receiving site.

C. Application to Use Transferable Development Rights: An application for use of transferable development rights on a property in a Receiving Area shall be submitted in conjunction with an application for a development permit. In addition to the information required for the development permit, the following shall be submitted:

1. Affidavit of intent to transfer development rights to the receiving property;
2. Certified copy of the Transfer of Development Rights Certificate for the sending site; and
3. Certified copy of the recorded Declaration of Restriction of Development and Easement.

D. Use of TDRs Voluntary: An owner of record in a Receiving Area choosing not to participate in the TDR Program shall retain the option to develop the property as provided by the property's existing zone district and applicable requirements of this code.

Monitoring TDR Certificates

The [*name of local government*] Planning Department Director or designee shall be responsible for maintaining permanent records of all TDR Certificates issued, easements recorded, and development rights transferred to receiving sites or purchased and held by a conservation organization or otherwise extinguished. An annual summary of TDR Certificates issued shall be prepared by the Planning Department and submitted to the [*name of local governing body*] for information.

Monitoring TDR Certificates: *Tracking development rights severed from a sending site is critical to a TDR program's success. The details of the tracking system do not need to be in the ordinance, but requiring it is a critical part of the program and identifying who is responsible ensures it will be done. Planners will need to consult the records when reviewing applications for development in sending and receiving areas.*

TDR Bank (Optional)

A TDR bank is not a requirement for a TDR program to be successful but can be a useful tool for implementing the program and ensuring effective long-term, consistent

program administration. A TDR bank is a freestanding entity that may be run by the local jurisdiction or by a participating partner organization such as a trust or other nonprofit. It is intended to help bridge the gap between sellers and buyers of TDRs, stabilize TDR prices, and market the TDR program. TDR banks also can be authorized to buy and sell TDRs, as well as buy and hold development rights for future acquisition. Proceeds from the sale of "banked" TDRs may be used to buy TDRs in key areas to further the goals of the program. King County, Washington, has a successful TDR program with an active TDR bank. See link below under examples.

An example of a purpose statement for a TDR bank is below. Typically, an ordinance creating a TDR bank also details who administers the bank, funding mechanisms for the bank, duties and authority of the bank, procedures for sale and purchase of TDRs, and monitoring and reporting of transactions.

A. Purpose: The TDR bank is intended to facilitate the implementation of the TDR Program and the purchase and sale of transferable development rights as allowed in this section. The TDR bank may acquire development rights from Sending Areas and sell development rights for use in Receiving Areas as designated on the Official Transferable Development Rights Map.

Key Facts

Administrative capacity	Experienced planner with city or county attorney to write ordinance. Skilled planners to administer program and track implementation
Mapping	Technical mapping of sending and receiving areas is typically required
Regulatory requirements	Land use regulations such as a zoning code and/or subdivision regulations. An intergovernmental agreement (IGA) is typically used if the TDR program is administered as a joint initiative between multiple jurisdictions
Maintenance	Yes, requires extensive on-going tracking mechanism for TDRs

Adoption required	Yes, the requirements and conditions for TDRs must be specified in the local land use regulations
Statutory reference	General zoning and land use regulatory authority. Home rule authority. See earlier discussion in the *Planning Framework*
Associated costs	Extensive staff time. TDRs will require outside consulting for land value expertise and dedicated staff for long-term maintenance of the program

Examples

Boulder County Land Use Code	https://www.bouldercounty.org/property-and-land/land-use/planning/transferable-development-credits-tdc/ Section 6-700
City of Fruita Land Use Code	fruita.org/sites/default/files/fileattachments/community_development/page/242/17.09.pdf Chapter 17.09 TDR
Mesa County Land Development Code	https://webdev.mesacounty.us/globalassets/planning/land-conservation/transferable-development-rights---credits-tdr-c/general-overview.pdf Section 9.8 Transferable Density Credits
Pitkin County Land Use Code	https://pitkincounty.com/DocumentCenter/View/5858/chapter-06?bidId= Section 6-70
Routt County PDR program	www.co.routt.co.us/DocumentCenter/View/16/PDR-application?bidId=
Summit County TDR program	http://co.summit.co.us/187/Transferable-Development-Rights
King County, Washington TDR bank	https://kingcounty.gov/services/environment/stewardship/sustainable-building/transfer-development-rights/bank.aspx

For More Information

American Planning Association Planning Advisory Service - PAS Memo May/June 2010: "TDR-Less TDR Revisited."
https://smartpreservation.net/wp-content/uploads/2011/07/TDR-Less_TDR_Revisited_PAS_Memo2.pdf

Protecting Sensitive Areas

The protection of environmentally sensitive areas is a high priority for many communities in Colorado. These areas offer a variety of benefits including beautiful scenery, opportunities for outdoor recreation, and plant and animal habitat, to name a few. Preserving sensitive areas often provides an additional benefit of protecting citizens and property against natural hazards. For example, protection of floodplains and the wildland-urban interface not only safeguard natural resources; they also help reduce vulnerability to flood and wildfire hazards. Additionally, protecting natural areas helps meet other community goals such as providing for open space, parks and recreation, and habitat conservation.

Protecting sensitive areas can be accomplished through mandatory tools (such as zoning and subdivision regulations) or through incentive-based approaches (such as optional cluster subdivisions). Generally, protecting sensitive areas can be accomplished at various stages of the planning and entitlement process, including:

1. **Comprehensive plan.** The plan identifies sensitive areas, hazard areas, and other locations that may be unsuitable or less suitable for development. It also offers a chance to prioritize protection of such areas alongside other important community goals.
2. **Zoning district designation (and subsequent rezoning).** A property's zoning district designation identifies the land use activities that may take place on the site. Placing an initial zoning district designation on a site, and also subsequent rezoning of the property, are important opportunities for the community to reflect on and implement the comprehensive plan and other supporting plans and policies. If sensitive areas are marked for preservation, then their zoning classifications should only allow appropriate densities and uses. This step is critical for establishing limitations on development of sensitive areas.
3. **Subdivision.** Once an area has been zoned, subdivision and development can occur. Although the zoning of a property prescribes the density and intensity of development, subdivision regulations provide an additional opportunity to ensure appropriate layout of individual sites, including lot and block design, street layout, and connections to surrounding areas. Planners can apply special standards to subdivision of sensitive areas (such as allowing cluster development to preserve sensitive

Protecting sensitive areas creates positive interaction between the built and natural environment.

Source: Arina P. Habich

areas or requiring multiple points of egress for emergency vehicles).

4. **Building permits.** Once a development has been approved, the building permitting process is another opportunity for communities to ensure that sensitive areas are protected. Permits must demonstrate how a proposed building complies with applicable health and safety codes (such as building and fire).
5. **Maintenance.** After a property is developed, communities and landowners have to be diligent to ensure that sensitive areas are continually protected from risk to hazards. For example, maintaining defensible space on a property in the wildland-urban interface means continuing to prune trees and remove brush to prevent build-up of fuels. This requires attention by landowners, but also from the community through ongoing enforcement of maintenance requirements.

Tools and Strategies

This section explores tools that communities can use to advance their goals of protecting sensitive areas. Tools profiled in this section include:

- 1041 Regulations
- Cluster Subdivision
- Conservation Easement
- Land Acquisition
- Overlay Zoning
- Stream Buffers and Setbacks

Manufactured Housing – Location, Location, Location!

Source: Shutterstock

Today's manufactured homes are dramatically different in appearance from the "mobile homes" of yesteryear, with estimates that more than 90 percent of today's manufactured homes never move from their original site. Manufactured homes, like stick-built homes, are now available in a variety of designs, floor plans, and amenities. In terms of hazard risk, the concern with manufactured homes is not their structural integrity, but rather their location. Like stick-built housing, if manufactured housing is located in the floodplain, they are at risk of being damaged by an event like the Front Range storm in 2013.

In the City of Evans, 203 manufactured (formerly "mobile") homes were destroyed when the South Platte River flooded in 2013. The major flooding issues had nothing to do with the structural integrity of manufactured housing, but its location within the floodplain. Each of the manufactured homes destroyed were constructed to the HUD 3280 Construction Standard. Following the 2013 floods, the City revised its municipal code to address development in the floodplain. Under the new code, construction in special flood hazard areas requires both manufactured housing and stick-built housing to be elevated to 36 inches above base flood elevation.

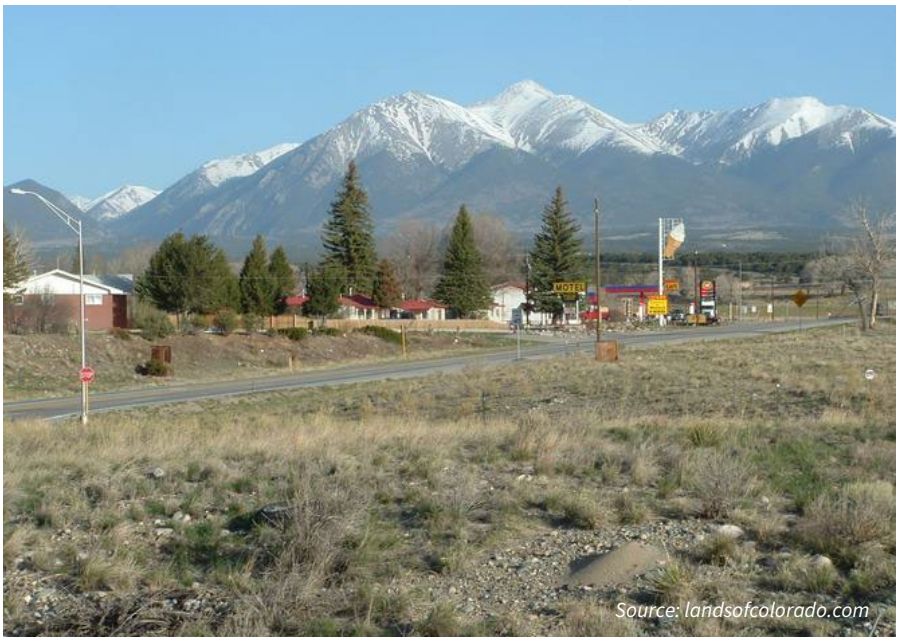
Citations:

- David Burns, Emergency Management Coordinator, City of Evans, Colorado, Personal Communication, August 2015.

References:

- Manufactured Housing Institute manufacturedhousing.org/default.asp
- Colorado Department of Local Affairs, Division of Housing https://www.colorado.gov/pacific/dola/division-housing
- Evans Municipal Code, Chapter 16.04.200 Specific standards for construction in special flood hazard areas: evanscolorado.gov/municipalcode/1604-flood-damage-prevention
- Longmont Municipal Code, Chapter 20.20 Provisions for Flood Hazard Reduction: municode.com/library/co/longmont/codes/code_of_ordinances?nodeId=PTIICOOR_TIT20FLRE

1041 Regulations



Source: landsofcolorado.com

How it Works

In 1974, Colorado enacted House Bill 1041, which gives local governments additional authority for planning decisions related to areas or activities of statewide concern. This bill allows communities to identify, designate, and regulate those activities and areas through a local permitting process commonly known as "1041 regulations." The law was enacted to help clarify the roles and responsibilities of state and local governments in reviewing development projects that may have impacts beyond the local jurisdiction, and generally, the law allows the local jurisdiction to retain and increase control over such projects that may otherwise be out of their jurisdiction or control (such as siting of highways or airports). The statute identifies four areas and ten activities of statewide interest:

Areas of Interest:

- Mineral resource areas
- **Natural hazard areas**
- Areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance
- Areas around key facilities in which development may have a material effect upon the key facility or the surrounding community

Activities of Interest:

- Site selection and construction of major new domestic water and sewage treatment systems and major extension of existing domestic water and sewage treatment systems

- Site selection and development of solid waste disposal sites except those sites specified in statutes
- Site selection of airports
- Site selection of rapid or mass transit terminals, stations, and fixed guideways
- Site selection of arterial highways and interchanges and collector highways
- Site selection and construction of major facilities of a public utility
- Site selection and development of new communities
- Efficient utilization of municipal and industrial water projects
- Conduct of nuclear detonations
- The use of geothermal resources for the commercial production of electricity

Communities may choose to adopt 1041 regulations for any or all of these areas or activities of state interest. Once adopted, development activities in these designated areas or activities are required to obtain a 1041 permit from the local jurisdiction, unless otherwise exempted by statute or local regulations.

Implementation

Communities considering adopting 1041 regulations should first consult their attorneys. The enabling statutes (C.R.S. Title 24, Article 65.1) define when and where 1041 regulations could apply to new development, which types of developments are exempt from 1041 regulations, guidelines for administration of the permitting process, and the respective roles of local governments and state agencies. C.R.S. § 24-65.1-202 includes criteria for administration of areas and activities of state interest. Those criteria prescribe how natural hazard areas shall be administered, including floodplains, wildfire areas, and geologic hazard areas.

These regulations can be integrated directly into existing land development regulations. For example, in addition to planned unit development (PUD) and/or annexation procedures, a community could describe the procedures for 1041 permitting in the same procedures chapter. When adopting 1041 regulations, communities must first identify areas and/or activities of state interest prior to enforcing the permitting process. Communities should also be sure to review other land use regulations and policy documents for consistency with any new ordinance in terms of definitions, procedures, exemptions, and enforcement authorities.

Chaffee County, CO.

Source: J. Norman Reid

Where It's Been Done

Chaffee County, Colorado, has adopted several types of 1041 regulations, including wildlife protection, geothermal energy, water and sewage treatment systems, and development of new communities. Each application of the 1041 regulations has been adopted through a separate chapter of the

county code. The siting and development of new communities is addressed in Chapter 8 of the county's 1041 regulations and is intended to provide orderly development while reducing the impacts to the natural environment. As part of that 1041 permitting process, the county generally defines "new communities" as those needing to incorporate, or involving an extension of water and sewer services. New communities are required to identify potential natural hazards and also provide adequate mitigation to reduce the impacts of such hazards, among other approval criteria (*Chaffee County Land Use*, n.d.).

Many other Colorado municipalities and counties use 1041 regulations to review areas and activities of state interest, and it is common for the submittal requirements and approval criteria to include identifying and addressing natural hazards. For an inventory of Colorado counties and municipalities that have adopted 1041 regulations related to natural hazards, see the Colorado land use survey reports at: colorado.gov/pacific/dola/land-use-survey. The survey documents that 19% of the jurisdictions responding to the survey used 1041 regulations for natural hazard areas.

Advantages and Key Talking Points

Adopting 1041 regulations may offer the following advantages:

- Provide an opportunity to consider potential impacts of natural hazard areas on the proposed infrastructure or development proposal.
- Allow local governments to review, comment, and impart change to proposed projects by statewide agencies that may impact the community.
- Provide a venue for public comment (during a public hearing) on activities and areas of state interest.
- Ensure that statewide interests are met without compromising the interests of local communities.
- Can be easily integrated directly into an existing land use code.

Challenges

Administering 1041 regulations can also come with the following challenges:

- Requires designation of areas and activities of state interest prior to regulating them.
- Adds another procedure to land use and development codes, often with a unique set of definitions and approval criteria.
- Enabling statute is very prescriptive in terms of administration and criteria.

Model Code Language and Commentary

One key use of 1041 regulations is to address development activity in natural hazard areas. Three specific natural hazards can be addressed through 1041 regulations:

- Flood
- Geologic hazard areas
- Wildfire hazard areas

Below are samples of 1041 permit review language for each of these natural hazard designations. While 1041 regulations may be tailored to fit individual conditions, much of the language found in local 1041 regulations is directly from the state statute. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language is based on existing ordinances from communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Flood

Commentary

A. Definition and boundaries: The requirements and standards in this section apply to mapped floodplain hazard areas as depicted in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), National Flood Insurance Program (NFIP), and to areas later mapped and found to be in flood hazard areas.

1. Floodplains shall not be designated by [*City Council or Board of County Commissioners*] unless the Colorado Water Conservation Board (CWCB), through the local conservation district, identifies such area for designation.
2. These regulations apply if development is not otherwise regulated under other provisions of this code regulating floodplains.

B. Standards for Review: The permit authority shall grant approval of a development proposed in a flood hazard area if the following standards, in addition to

Authority for External Review: *1041 powers also allow local jurisdictions to review and regulate projects proposed by a state agency, other governmental authority, or special district that may otherwise be exempt from local land use review and permitting procedures.*

Location of 1041 Regulations: *Most local governments adopt separate 1041 regulations that re-state the procedures included in state statutes. However, some have merged their 1041 process with other land use approval processes to minimize repetition and consolidate review times.*

Flood Hazard Mapping: *Some communities may use other sources for their flood hazard mapping. Sources normally used by local authorities to set floodplain boundaries and enforce regulations should be referenced here.*

Permit Authority: *The permit authority is authorized by the local governing body and should be identified along with the process for designating a natural hazard area for 1041 regulations in the procedural section of the local land development code.*

the general standards for 1041 natural hazard area review, are met:

1. Land use shall preserve the integrity of the flood hazard area by not altering or impacting it in any way which is likely to pose a significant threat to public health or safety or to property (including the subject property, other impacted properties, or the environment).
2. Development that, in time of flooding, will likely pose a significant threat to public health or safety or to property (including the subject property, other impacted properties, or the environment), shall be prohibited. In determining whether there will likely be a significant threat, the following factors shall be considered:
   - **a.** Creation of obstructions from the proposed development during times of flooding;
   - **b.** Vulnerability of the proposed development to flooding;
   - **c.** Use of flood protection devices or floodproofing methods;
   - **d.** Nature or intensity of the proposed development;
   - **e.** Increases in impervious surface area caused by the proposed development;
   - **f.** Increases in surface runoff flow rate and amount caused by the proposed development;
   - **g.** Increases in flood water flow rate and amount caused by the proposed development;
   - **h.** Proximity and nature of adjacent or nearby land uses;
   - **i.** Impacts to downstream properties or communities; and
   - **j.** Impacts on shallow wells, waste disposal sites, water supply systems, and sewage disposal or on-site wastewater systems.
3. Development shall comply with all other Floodplain regulations of this code.

Geologic Hazard Area

A. Definition and boundary: All geologic hazard areas delineated on the Geologic Hazard Map for *[name of local government]*, available at the [*Planning Department*], are subject to review and permitting under this section. Geologic hazard areas included on the Geologic Hazard Map are defined as follows:

1. "Avalanche" means a mass of snow or ice and other material which may become incorporated therein as such mass moves rapidly down a mountain slope.
2. "Expansive soils and rocks" means any mineral, clay, rock or other type of geologic deposit having the property of absorbing water with an accompanying swelling to several times their original volume.
3. "Geologic hazard" means a geologic phenomenon that is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes, but is not limited to: avalanches, landslides, rock falls, mudflows, unstable or potentially unstable slopes, seismic effects, radioactivity, and ground subsidence.
4. "Geologic hazard area" means an area which contains or is directly affected by a geologic hazard.
5. "Ground subsidence" means a process characterized by the downward displacement of surface material caused by natural phenomena such as removal of underground fluids, natural consolidation or dissolution of underground minerals, or man-made phenomena such as underground mining.
6. "Initial control area" means an area suspected, but not finally determined, to be a natural hazard area or a mineral resource area. "Landslide" means a mass movement where there is a distinct surface of rupture, or zone of weakness, which separates the slide material from more stable underlying material.

Geologic Hazards: *Each local community should include only those geologic hazards mapped in their community and found within the area designated as a geologic natural hazard. The definitions shown here are from the state statute. Most communities incorporate the state definitions and procedures into their 1041 regulations.*

7. "Mudflow" means a flowing mass of predominately fine-grained earth material possessing a high degree of fluid during movement.
8. "Nonconforming use" means any structure, development, or land use in existence as of the date of the adoption of these regulations, and not permitted under the terms and provisions of these regulations.
9. "Radioactivity" means a condition related to various types of radiation emitted by natural radioactive minerals that occur in natural deposits or rocks, soils, and water.
10. "Rock fall" means the rapid free-falling, bounding, sliding, or rolling of large masses of rock or individual rocks.
11. "Seismic effects" means direct and indirect effects caused by a natural earthquake or a man-made phenomenon.
12. "Unstable or potentially unstable slope" means an area susceptible to a landslide, a mudflow, a rock fall, or accelerated creep of slope-forming materials.

B. Standards for Review: The permit authority shall approve an application for a permit for development in a geologic hazard area if all of the following criteria are met:

1. Provision shall be made for the long-term health, welfare, and safety of the public from geologic hazards to life, property, and associated investments.
2. Permitted land uses, including public facilities, which serve such uses shall avoid or mitigate geologic hazards at the time of initial construction.
3. Man-made changes shall not initiate or intensify adverse natural conditions within a geologic hazard area.
4. Recommendations concerning the proposed development in the designated geologic hazard area by the Colorado Geological Survey shall be solicited and considered. The Colorado Geological

Review by State Agencies: *Colorado statutes (§24.65.1-301 and 302) state that it is the function of local governments to receive recommendations from state agencies, and it is the function of state agencies to provide recommendations and technical assistance concerning the designation and guidelines for matters of state interest.*

Survey shall be allowed no less than twenty-four (24) days in which to respond to such referrals.

Wildfire Hazard Area

A. Definition and boundary: All wildfire hazard areas delineated on the Wildfire Hazard Map for *[name of local government]*, available at the [*Planning Department or equivalent*], are subject to review and permitting under this section.

B. Standards for Review: The permit authority shall approve an application for a permit for development in a wildfire hazard area if all of the following criteria are met:

1. Any authorized development will have adequate roads for service by fire trucks, fire-fighting personnel, and other safety equipment, as well as fire breaks and other means of reducing conditions conducive to fire.
2. All precautions required to reduce or eliminate wildfire hazards will be provided for at the time of initial development.
3. A Wildfire Mitigation or Forest Management Plan will be prepared by a professional forester, reviewed and approved by [*name of local government*] [*Planning Department or equivalent*] and executed prior to issuance of building permits.
4. The development will adhere to the guidelines and criteria for Wildfire Hazard Areas promulgated by the Colorado State Forest Service.

Key Facts

Administrative capacity	Requires experienced planning staff to administer. These permitting procedures are similar to other development review procedures in a typical land use code
Mapping	Mapping of hazard areas (known or potential) are often required with a 1041 application submittal

Regulatory requirements	Can work in tandem with other land use regulations; however, a land use code is not necessarily required to administer 1041 permitting procedures
Maintenance	Typical maintenance of ordinance and procedures. Also requires monitoring statutory requirements for changes for designated areas and activities of state interest
Adoption required	Yes, 1041 regulations require adoption by ordinance
Statutory reference	C.R.S. Title 24, Article 65.1. The statutes identify the general provisions, permitting procedures, and criteria for areas and activities of state interest
Associated costs	Staff time and resources required to adopt and maintain a new ordinance

Examples

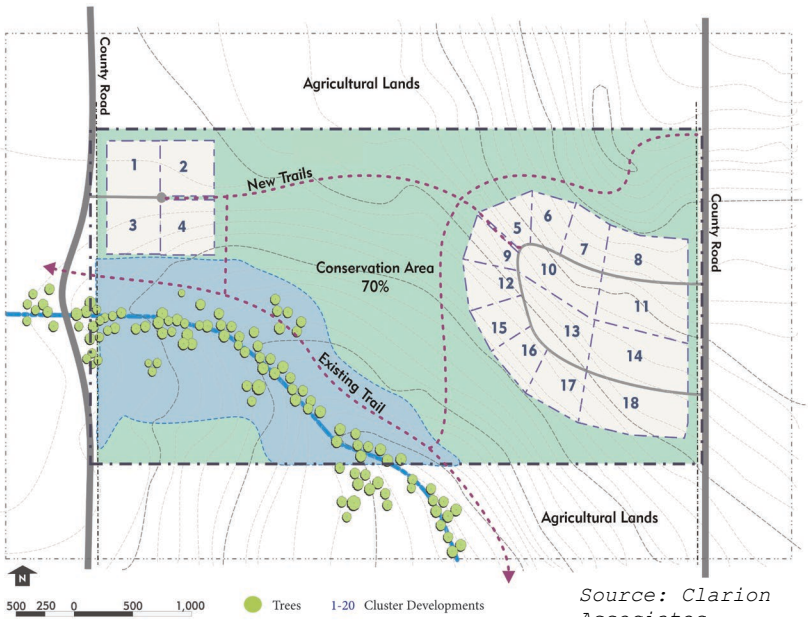
Boulder County 1041 Regulations	https://www.bouldercounty.org/property-and-land/land-use/planning/review/1041-review/
Chaffee County 1041 Regulations	chaffeecounty.org/Planning-and-Zoning-Land-Use-Code
DOLA Model Codes 1041 Regulations	colorado.gov/pacific/dola/1041-regulations
City of Golden Areas and Activities of State Interest	https://library.municode.com/co/golden/codes/municipal_code?nodeId=TIT18PLZO_CH18.80ARACSTIN Chapter 18.80
Pueblo County Areas and Activities of State and Local Interest	http://county.pueblo.org/government/county/code/pueblo-county-code-title-17-division-2-areas-and-activities-state-and-local-interest Title 17, Division II Areas and Activities of State and Local Interest, Chapter 17.148 et. seq.
San Miguel County Areas and Activities of Local and State Interest	https://co-sanmiguelcounty-old.civicplus.com/DocumentCenter/View/214/Article-5---Standards-PDF?bidId= Article 5 Standards, Section 5-4: Areas and Activities of Local and State Interest/”1040” Environmental Hazard Review

For More Information

Colorado Land Use Survey

colorado.gov/pacific/dola/land-use-survey

Cluster Subdivision



Hazards Addressed

How it Works

Cluster subdivisions are a land development tool used by communities to protect open space or environmentally-sensitive lands, including hazard-prone lands. Clustering development simply means grouping or directing new development to relatively less sensitive areas within a subdivision, away from more sensitive areas like open space, steep slopes, or floodplains. Cluster subdivisions (also sometimes known as "conservation subdivisions") generally do not increase the overall density of a development but rather allow dwellings to be grouped (or "clustered") on smaller lots away from sensitive areas such as rivers or defined natural hazard areas. The key benefit to a developer is smaller lot sizes than otherwise permitted by the subdivision regulations in exchange for the conservation of sensitive lands. A developer also may benefit from local incentives that encourage the use of clustering, such as density bonuses, or state incentives, such as water rights.

Implementation

Cluster subdivisions are implemented through a community's subdivision regulations. Subdivision regulations are a community's opportunity to address new development in terms of location and density of lots, protection of environmentally-sensitive areas, and to meet other community goals. Communities that are interested in establishing cluster subdivision provisions can do so via a new ordinance or by amending their existing subdivision ordinance. Cluster subdivisions can be mandatory or used as an optional incentive in combination with other tools such as density bonuses and/or transfer of development rights (TDRs), both of which are addressed separately in this guide.

When developing a cluster subdivision ordinance, the community should:

- Identify the purposes behind the program, such as maintaining rural character, protecting valuable resources, creating defensible space, and/or avoiding development on hazard–prone land.
- Develop a set of clear thresholds that identify when and/or where cluster subdivisions are required and the minimum requirements for approval.
- Include provisions for the ongoing maintenance of required open space.
- Include standards for acceptable cluster designs, as well as graphics similar to the one at the start of this section to illustrate such strategies.

Where It's Been Done

Longmont authorizes cluster lot subdivisions in its Land Development Code. Cluster lot subdivisions must be located in certain zoning districts and be of a minimum overall site area. While not explicitly designed to avoid hazard-prone lands, they are intended to create more compact residential developments to preserve and maintain open areas and natural lands (which often can include areas prone to hazards). They must provide common open space that meets specified requirements. Cluster lots are permitted in the R-1 and R-2 zoning districts, where minimum lot sizes are normally 5,500 and 5,000 square feet, respectively, for a single-family detached dwelling, but may be reduced in a cluster development to 3,000 square feet. The maximum development density is still limited to the R-1 and R-2 standards. Other minimum dimensional standards are also reduced for cluster subdivision lots in these districts, such as lot widths and setbacks. Approval of cluster lot subdivisions must follow the procedures for standard subdivisions in Longmont (*Code of Ordinances*, 2015).

Many other jurisdictions also have cluster subdivision provisions. For example, **Summit County's** Rural Land Use Subdivision (RLUS) process offers developers the opportunity to create smaller lots with lower infrastructure costs. Density bonuses are available based on the amount of, and restrictions placed on, the accompanying open space (*Summit County Land Use*, 2013, p. 33).

Advantages and Key Talking Points

The primary benefit to adopting cluster subdivision regulations is the protection of environmentally sensitive areas and, in the case of hazard mitigation, protection of areas that pose risk to development. The development community also benefits from cluster subdivisions through paired incentives such as density bonuses. Other advantages include:

- There are synergies with other community goals and assets. Clustering development allows communities to protect development from hazard areas, while also conserving other sensitive areas such as wildlife habitat and migration corridors.
- The footprint of new development is reduced. When development is clustered, the needs for grading, paving roads, and laying infrastructure are diminished.
- Long-term maintenance costs are reduced. Because cluster development has a smaller footprint, this can equate to lower costs for maintaining roads, infrastructure, and other public or private amenities.

- Cluster subdivisions can be tailored to any Colorado community. Depending on political climate and demand, cluster subdivision can be mandatory or optional, and can be implemented through rigorous or more flexible standards. Tying cluster subdivision to other incentives such as TDRs or density bonuses is also optional.
- Property values may rise. Clustering has the potential to increase property values, since individual lots will enjoy access to an increased amount of open space.
- Varied housing stock. Cluster subdivisions often mean smaller lots, which can result in smaller dwellings, meeting diverse community housing needs.
- Wildfire risk reduction in the wildland-urban interface (WUI). Clustering lots away from the wildland-urban interface can reduce the wildfire risk to property and life.

Challenges

Developing a cluster subdivision ordinance is relatively straightforward because there are many successful models in use around Colorado; however, there are some costs and challenges associated with the process.

- Less developable land. Without other incentives, developers may be forced to build smaller homes on smaller lots, making it difficult to maximize profit.
- Significant increases in property values can displace vulnerable populations. Ensuring that residents in the community have attainable and affordable housing options can be difficult amongst competing interests. Plans described in this Guide should address these challenges.
- Higher open space maintenance costs. Depending on the particular subdivision, the burden of maintaining the protected or open areas could become the responsibility of the developer or a subsequent metropolitan district or homeowners association. If dedicated to the local government, maintaining those areas becomes the responsibility of that jurisdiction.

Model Code Language and Commentary

While cluster subdivision regulations should be tailored to the needs of each individual community, there are some basic components found in most cluster subdivision ordinances throughout Colorado, including:

- Purpose
- Applicability
- Incentives and benefits
- Cluster subdivision standards
- Review procedures

The following sections describe each of the common elements and provide standard language that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in

Commentary

Purpose Statement: *The purpose statement is the jurisdiction's opportunity to describe the intent and benefits of the cluster subdivision procedures. Typically, the primary purpose of cluster subdivision is to allow for more compact development in exchange for preserving natural areas, open areas, or natural hazard areas. Communities also frequently tie the purpose of cluster subdivisions to their comprehensive plan policies.*

italics in the column at the right. The model language used in this document is based on existing ordinances from communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose

The purpose of the cluster subdivision procedure is to:

A. Preserve open areas in the [*town/city*] planning area;
B. Further the goals, policies, and policies set forth in the Comprehensive Plan;
C. Encourage flexibility and innovation through incentives;
D. Encourage development patterns that promote more efficient use of land;
E. Avoid development in known hazard areas;
F. Protect and enhance environmentally-sensitive areas; and
G. Promote an economical layout and street design that reduces infrastructure costs.

Applicability

A. Cluster subdivisions are permitted in the [*name of district(s)*] zoning districts.
B. Clustering of lots is required in the following:
   1. New subdivisions in the [*name of district(s)*] zoning districts.
   2. New subdivisions in a wildfire hazard area of [insert range of severity level of mapped wildfire hazard areas].

Incentives and Benefits

The [*Planning Commission, City Council, Board of Trustees, Board of County Commissioners, etc.*] may approve one or more of the following incentives in connection with the approval of a cluster subdivision application:

Applicability: *Cluster subdivision can either be mandatory or optional. Many communities limit the districts where clustering benefits can be achieved (such as low-density residential or agricultural districts). For mapped hazard areas, communities can require clustering in certain instances (e.g., high to extreme wildfire hazard rating). Mapping can be tied to the comprehensive plan or hazard mitigation plan.*

Incentives and Benefits: *This section describes any benefits that the developer achieves by clustering development, such as reduced setbacks, additional lots, increased density, and expedited review procedures. The opening statement to this section should include the appropriate approval body for subdivisions.*
Other benefits, such as the potential for increased open space, increased property values, and protecting known hazard areas from development can be included in this section, if desired.
Communities often allow for more flexible lot and dimensional standards such as small lot sizes and setbacks without allowing an increase in the overall net density of the development.
Greater densities than shown in the table can be permitted through cluster subdivisions and PUDs than can be achieved using the cluster development procedures authorized under C.R.S. 30-28-401. The trade-off for the greater flexibility of cluster subdivisions is a more involved and lengthy review and approval process.

Greater densities than shown in the table can be permitted through cluster subdivisions and PUDs than can be achieved using the cluster development procedures authorized under C.R.S. 30-28-401. The trade-off for the greater flexibility of cluster subdivisions is a more involved and lengthy review and approval process.

A. Expedited review process (such as 30 days for approval);
B. Priority application review status (moves to the top of the list);
C. Density bonuses as follows:

	[*name of district*]	[*name of district*]
Maximum density without clustering (DU/acre)	0.2	0.5
Maximum density with clustering (DU/acre)	1.0	2.0

D. Density bonus(es) up to one additional buildable lot per 17.5 acre increment; and
E. Reduced minimum lot sizes in the [name of district(s)] zoning districts.

Preserving Common Open Space: *The option for preserving common open space can include other minimum percentages; however, 30 percent is common. The options for preservation (deed restrictions, land dedication, or conservation easements) should be discussed during a pre-application meeting between the local government and the applicant to determine the most effective approach.*

Cluster Subdivision Standards

This section describes the minimum requirements for designing cluster subdivisions.

Minimum Project Size: *The minimum size for a cluster subdivision refers to the overall subdivision, not an individual lot. Not all communities require a minimum project size for cluster subdivision. The advantage of having a minimum project size is to prevent one-off subdivisions that try to increase density on small projects without any significant benefit to the community through preservation.*

Flexible Lot Standards: *Most cluster subdivision ordinances allow for a greater degree of flexibility on individual lot dimensional standards. The table included at left is an example of how a community might communicate adjusted development standards for cluster subdivisions. This section should cross-reference other applicable district-specific regulations and/or development standards that would otherwise apply, then modify applicable standards in a table or list. This sample language suggests additional adjustments to lot standards be allowed for cluster lots when they abut required common open space areas.*

A. Site Layout

1. In cluster subdivisions, a minimum of [*30 percent*] of the development shall be preserved as common open space, and shall be permanently maintained and protected as:
   - **a.** Common open space with deed restrictions;
   - **b.** Land dedication to the town; or
   - **c.** Protected through a conservation easement.
2. Where possible, structures shall be oriented to preserve scenic views, natural topography and drainage ways, solar orientation, and other important natural features of the site.
3. Buildable lots shall be located to minimize the impacts of clearing, grading, and infrastructure development on riparian areas, steep slopes, wetlands, woodlands, or other known natural hazard areas.

B. Dimensional Standards

1. A cluster subdivision shall be a minimum of [*10 acres*].
2. All dimensional standards from [*Section X.X]* shall apply to cluster subdivisions unless otherwise stated in this section.
3. Buildable lots in a cluster subdivision shall follow the following standards:

	[***name of district***]	[***name of district***]
Minimum lot size	4,000 sf	6,000 sf
Minimum lot width	25 feet	40 feet
Minimum setbacks		
Front	15	20
Side	5	10
Rear	5	10
Maximum block length	600 feet	600 feet

4. Minimum setbacks may be further reduced by the [*Director*] where such setbacks are adjacent to required common open space areas.

Review Procedures

Review and approval procedures for cluster subdivisions should include similar procedural steps and approval criteria to those required for preliminary and final plats. Some codes may allow for minor subdivision approval for cluster subdivisions creating fewer than 4 or 5 lots.

Many communities include cluster subdivisions as part of a subdivision exemption procedure. The review procedures for subdivisions, including cluster subdivisions, often follow the statutory language closely. This allows statutory counties to regulate cluster subdivisions while ensuring that they remain in compliance with state law. It is important for city and county attorneys to review any changes to state statutes that would necessitate an update to their cluster subdivision regulations.

This section describes the procedures for cluster subdivision review and approval.

A. Review and approval of a cluster subdivision shall follow the procedures for a sketch plan, preliminary

plat, and final plat in [*Section X.X, Subdivision Approval Procedures*].

B. The following additional approval criteria shall apply for cluster subdivisions:

1. The proposed development will preserve [*in perpetuity (or at least 40 years)*] high-priority environmental resources, agricultural land, natural hazard areas, or open space;
2. Density bonuses will not result in adverse impacts to adjacent properties, or such impacts have been identified and appropriately mitigated (through tools such as landscaping buffers, building stepbacks, screening, etc.);
3. Existing infrastructure is available, or will be available, to serve the proposed cluster subdivision.

Key Facts

Administrative capacity	Experienced planners with city or county attorney to write regulations and normal capability to administer the standards once adopted
Mapping	Not required, but sample cluster subdivision layout drawings help illustrate the desired result through the cluster subdivision process
Regulatory requirements	Subdivision ordinance required to effectively administer cluster subdivisions
Maintenance	Minimal
Adoption required	Yes
Statutory reference	The adoption of subdivision regulations is authorized for municipalities and required for counties through detailed enabling legislation (C.R.S. § 30-28-133 for counties and § 31-23-214 for municipalities). Local governments may adopt cluster subdivision provisions as part of this general enabling authority
Associated costs	Staff time and ordinance development or amendment costs

Examples

Archuleta County Subdivision Regulations	http://archuletacounty.org/247/Land-Use-Regulations
City of Aurora Small Lot Development Standards	https://library.municode.com/co/aurora/codes/building_and_zoning
DOLA Model Codes Cluster Subdivision Regulations	colorado.gov/pacific/dola/land-use-codes
City of Durango Cluster Development	online.encodeplus.com/regs/durango-co
Larimer County Rural Land Use Process	https://www.larimer.org/planning/development/division/rural-land-use-process
City of Longmont Cluster Lot Subdivisions	https://library.municode.com/co/longmont/codes/code_of_ordinances
Town of Pagosa Springs Conservation Subdivisions	https://library.municode.com/CO/pagosa_springs/codes/code_of_ordinances
Routt County Land Preservation Subdivision	http://www.co.routt.co.us/194/Regulations
San Miguel County Areas and Activities of Local and State Interest	https://co-sanmiguelcounty-old.civicplus.com/DocumentCenter/View/214/Article-5---Standards-PDF?bidId=
Summit County Rural Land Use Subdivision Process	https://co-sanmiguelcounty-old.civicplus.com/DocumentCenter/View/214/Article-5---Standards-PDF?bidId=

For More Information

EPA's Essential Smart Growth Fixes for Rural Planning, Zoning, and Development Codes

epa.gov/smartgrowth/essential-smart-growth-fixes-communities

Conservation Easement

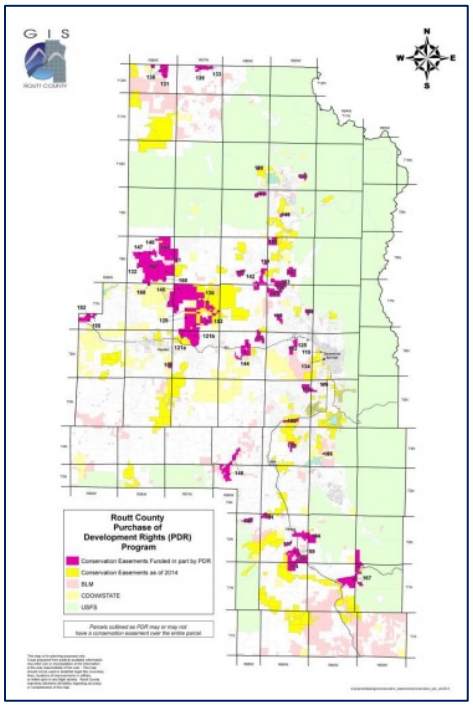

Source: Clarion Associates

Hazards Addressed

How it Works

A **conservation easement** is a specific type of restriction placed on land to protect open spaces and sensitive resources, such as areas prone to hazards. An easement limits the ability to use or develop the land in some way, while still allowing the property owner to live on and use the land, sell it, or pass it on to her heirs. The property is legally protected, usually permanently, from certain types of uses or development that would harm the resources being protected. Conservation easements have been used widely throughout Colorado to protect a variety of resources such as riparian areas, scenic views, farm and ranch land, wildlife habitat, and historic buildings. They are a good tool for communities that have identified specific privately owned areas for natural resource protection, hazard mitigation, watershed protection, open space, parks and recreation, or other public benefit.

Conservation easements for private property are volunteered or sold to land trusts or governmental agencies that have a stake in preserving the property's use through conservation. As with other



Map of Conservation Easements in Routt County, CO.

Source: Routt County

real property interests, the easement is recorded in local land records and becomes part of the title for the property.

They often are used in conjunction with cluster subdivisions; for instance, Summit County requires open space tracts within a Rural Land Use Subdivision to be covered by a conservation easement or similar instrument; the associated density bonus allowed is in large part determined by the type and term of the easement.

Implementation

Implementation of conservation easements requires collaboration between local governments, land trusts, and the owners of the property to be protected.

Conservation easements essentially involve private contracts, not public land use controls. Thus, in many communities, land trusts lead the way in setting up conservation easements, rather than local governments. Land trusts also typically have more resources readily available to establish and monitor easements, such as staff to monitor development activity and funding for carrying out the transactions. That is not to say that local governments cannot establish their own conservation easement programs. It simply requires a higher level of capacity to do so, and it is often easier for communities to coordinate with land trusts to maintain the easements. Some steps that can be taken by local governments to implement conservation easements include: mapping high-hazard areas, then identifying and partnering with a local land trust (often by approaching an organization such as the Colorado Coalition of Land Trusts), and then approaching landowners in high-hazard areas to gauge interest in establishing easements.

Where It's Been Done

In 2003 **Colorado Springs** coordinated with its Cedar Heights subdivision and a local land trust to protect a 295-acre park with a conservation easement to prevent any new residential development and create an open space buffer between the Pike-San Isabel National Forest and the community. The easement allowed for fire mitigation work to take place on 100 acres of the park which, in combination with defensible space around homes, was credited with helping to save the neighborhood from the 2012 Waldo Canyon Fire (*League*, 2012).

In 1996, voters in **Routt County** approved a property tax increase to establish a Purchase of Development Rights (PDR) Program. The purpose of the program was to provide funds for conserving private property from development for uses that are important to County citizens such as agriculture, recreation, and conservation uses. Citizens reaffirmed the program in 2005 and extended it until 2025.

As defined by Routt County, the PDR is a land protection tool in which a property's development rights are purchased from willing landowners. In exchange, the landowner grants a perpetual conservation easement, or deed restriction on the property, thereby permanently protecting the land from development. The land may be sold or transferred, but the deed restriction remains in place.

Since the program's inception, almost 40,000 acres have been protected through this program. Several of the properties that have been protected include floodplain areas that will be forever preserved from development pressures.

Larimer County instituted its conservation easement program in 1995. The *Help Preserve Open Spaces Initiative* has since resulted in over 8,000 acres of land protected as conservation easements. Much of the conservation easements in Larimer County exist to preserve agricultural property, though many easements protect natural areas, wildlife habitat, recreation areas, and wetlands from future development.

The conservation easement process in Larimer County is guided by the *Written Project Selection Criteria* that is used by county staff, the Larimer County Open Lands Advisory Board, and the Larimer County Board of County Commissioners to evaluate properties. All conservation easements are subject to a *Baseline Document Report* to determine the existing conditions of the property and the conservation benefit. Once established, all conservation easements within the county are monitored and conditions are reported on an annual basis.

Advantages and Key Talking Points

Some of the benefits of implementing conservation easements include:

- Provides a beneficial way to preserve private lands with intrinsic public value or hazard risk without the need to acquire or further regulate.
- Provides income tax and estate tax benefits for landowners.
- Provides a relatively inexpensive way to meet community goals for open space, hazard mitigation, parks and recreation planning, etc.

Challenges

Implementation of conservation easements can be cumbersome as there are many different players involved including, but not limited to, the landowner (and their families), community officials, land trust staff, realtors, and lawyers. Some conservation easements also require payment, which requires a dedicated funding source to administer. Tracking and monitoring CEs for compliance can involve staff resources. It is important to develop an adequate system for monitoring so development proposals and actions are consistent with the easements.

Key Facts

Administrative capacity	More advanced administrative capacity is needed to implement and maintain conservation easements
Mapping	Mapping of conservation areas is generally part of a local government's mapping program
Regulatory requirements	N/A, or jurisdictions

Maintenance	Maintenance of the conservation lands will be required by the community, the land trust or the landowner
Adoption required	No
Statutory reference	C.R.S. §38-30.5
Associated costs	Primarily only staff time for local governments. Requires funding to purchase properties if administered by local government

Examples

Boulder County Conservation Easements	https://www.bouldercounty.org/open-space/management/conservation-easements/
City of Colorado Springs Cedar Heights Conservation Easement	palmerlandtrust.org/news/open-space-proves-asset-fight-against-waldo-canyon-fire
Larimer County Conservation Easements	https://www.larimer.org/sites/default/files/uploads/2017/ces.pdf
Routt County Purchase of Development Rights Board	http://co.routt.co.us/110/Purchase-of-Development-Rights-Board

For More Information

Colorado Department of Regulatory Agencies
colorado.gov/pacific/dora

The Nature Conservancy: Conservation Easements
https://www.nature.org/en-us/about-us/who-we-are/how-we-work/private-lands-conservation/

https://www.nature.org/media/colorado/giving_cons_easement.pdf

Colorado Coalition of Land Trusts
https://www.coloradononprofits.org/membership/nonprofit-member-directory/nonprofit/760

The Trust for Public Land: A Return on Investment: The Economic Value of Colorado's Conservation Easements
http://cloud.tpl.org/pubs/benefits-CO-easements-taxcredit.pdf

Colorado Open Space Alliance (COSA): Colorado Open Space Programs
https://coloradoopenspace.org/about/

Great Outdoors Colorado (GOCO)
http://www.goco.org/blog/what-conservation-easement

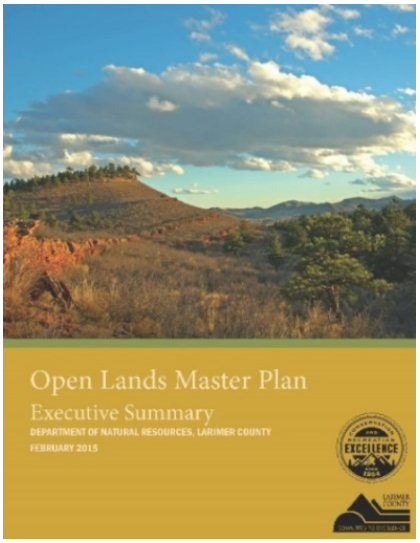
Land Acquisition

Source: City of Fort Collins

Hazards Addressed:

How it Works

Often the simplest, most effective way for government to protect an area is to acquire it. For the purposes of this document, the term **"land acquisition"** refers to the acquisition of private land by the government (local, state or federal) in fee simple (through purchase or donation). The related concept of acquiring conservation easements is discussed separately. Across Colorado, land acquisition is a tool that can help local governments achieve multiple community goals, such as watershed protection and provision of open space and parks. Land acquisition also can be an important mitigation technique to protect against hazards, by removing the development potential from vulnerable areas. Examples of lands that might be considered for acquisition for community hazard mitigation purposes include floodplains, areas of high wildfire risk, stream corridors, steep slopes, and/or other geologic hazards.



Cover from Larimer County's Open Lands Master Plan.

Source: Larimer County

Implementation

Land acquisition as a tool for protecting sensitive areas involves obtaining buy-in from the community's leadership and from the property owner. Implementing land acquisition programs requires political will, community support, and funding. For this reason, land acquisition can be one of the more difficult tools to implement.

Some of the more successful land acquisition programs in the country have addressed all three of these critical components. First, they are well-supported by the local governing body and the community, generally because of a high-priority community goal (open space preservation, hazard mitigation, protecting cultural resources, scenic lands, etc.). This often leads to the establishment of a funding mechanism for acquiring the sensitive lands that advance community goals. Some funding tools that have been implemented include direct line-item appropriations, taxes or fees such as stormwater utility fees, tax incentives, and bonds. In other instances communities may apply for grant funding (for example, Great Outdoors Colorado or FEMA Hazard Mitigation Assistance funding) and/or work in partnership with private or non-profit organizations to offset the full costs of property acquisition.

While land trusts are more often thought of as preservation organizations, they can also be used to assist communities with more traditional land acquisitions projects. Land trusts typically have more resources, such as staff and funding, readily available to assist communities with land acquisition projects. That is not to say that local governments cannot establish and manage their own land acquisitions programs. It does, however, require a higher level of administrative capacity to do so, and it is often easier for communities to coordinate with the land trusts to implement land acquisition programs.

Where It's Been Done

Often times, especially when done for hazard mitigation purposes, local communities will pursue the acquisition of individual land parcels on a case-by-case basis. Such was the case in 2011 when **Cañon City** successfully acquired a flood-prone residential property that had been experiencing repetitive losses and had become a chronic problem for the City's Engineering Department. Although not located in a mapped special flood hazard area, the home was built in an area that saw heavy stormwater runoff and would suffer flooding during even fairly small rainfall events. Through the assistance of a FEMA hazard mitigation grant and in coordination with the homeowners, who were eager to relocate, the City was able to acquire the property and replace the structure with permanent green space. The site is now filled with natural vegetation and serves to absorb stormwater flows and reduce the potential flood risk for neighboring properties (*Best Practices*, 2014, p. 23-24).

Larimer County and Estes Park, CO.

Source: Nataliya Hora

Since 1995 **Larimer County** has enforced a quarter cent, county-wide open space tax called the *Help Preserve Open Space Tax*. Funds are shared with all of the municipalities in the county to help maintain and expand the Larimer County Open Lands Program. With these funds Larimer County and its communities implement active open space preservation programs that promote land acquisition as a primary means of preservation.

The program originated from a grassroots effort of citizens determined to establish a county-wide open space program. By going door-to-door to ask other citizens to sign petitions, the initiative was eventually put before voters and was passed overwhelmingly. Since the tax was passed in 1995, over 43,000 acres have been preserved and in 2014 voters extended the program through 2043. One of the priority areas discussed in the Larimer County Open Lands Master Plan is river corridors. The plan recognizes the value of these lands as buffers that help mitigate property damage from flood and fires. The plan lays out procedures to ensure that conservation efforts along river corridors, including further implementation of land acquisition, will continue in the future (*Open Lands Programs*, n.d.b.).

Transfer of development rights (TDR) programs can be very effective in supporting land acquisitions. For instance, in the Upper Blue Basin of Summit County, the TDR program jointly administered by the county and the Town of Breckenridge has resulted in the public acquisition of over 1,050 acres of backcountry property and generated over $2 million for future land acquisitions (*Transferable Development Right*, n.d.). See *Transfer of Development Rights (TDRs)* earlier in this chapter for additional information.

Boulder County participates in FEMA's 404 program, commonly known as the "buyout" program whereby properties can apply to the local government for property acquisition if they meet FEMA guidelines for substantial damage following a disaster. The process can be lengthy, taking up to three years to complete. Planners should learn about the HMGP program before a flood to better understand who would qualify under the 404 program. One of Boulder County's biggest challenges has been communicating and finding alternative funding sources for property owners that did not qualify for the 404 program following the 2013 flooding events. For more information, contact Abby Shannon at 720-564-2623. The program is also discussed in the County's Flood Recovery Resource Guide from the following link: bouldercounty.org/doc/flood/floodrecoveryguide.pdf

Advantages and Key Talking Points

Some of the benefits of land acquisition include:

- Complementing policies and strategies found in a community's comprehensive plan or other plans associated with future land use, open space preservation, hazard mitigation, floodplain management, community wildfire protection planning, parks and recreation, and environmental protection.
- Promoting natural resource protection as a hazard mitigation technique.
- Providing locations for citizens to recreate.

- Protecting environmentally sensitive areas.
- Achieving the above objectives through a permanent solution versus relying on land development policies or regulations which may be changed over time.
- Preventing property damage and loss of life, thereby reducing public and private resources expended on disaster recovery.
- Preserving habitat for threatened species.
- Removing land from development pressure that might otherwise be highly desirable to developers.

Challenges

- Likely the greatest challenge for communities in implementing land acquisitions is the amount of money it takes to purchase sensitive lands.
- Land acquisition also requires resolving complicated coordination issues.
- Communities need a higher level of technical expertise to administer land acquisitions.
- Any land a jurisdiction acquires may be subject to easements that dictate how the land is to be maintained and used. If the land is located in a hazard area, staff must consider whether the easement requirements allow specific mitigation activity on the land.
- Finally, as previously mentioned, land acquisitions requires political will, community support, and financial capital, which may be challenging to obtain.

Key Facts

Administrative capacity	More advanced administrative capability and knowledge of real estate transactions are required to implement land acquisitions
Mapping	Can be coupled with open space or regular land use mapping but land acquisitions should become part of a community's mapping efforts
Regulatory requirements	N/A
Maintenance	Community maintenance of the acquired lands is required. Parks and Recreation Departments, Public Works Departments, etc. can assist with maintenance
Adoption required	Land acquisition policies may be included in comprehensive plans or other community plans that may be required to be adopted
Statutory reference	N/A
Associated costs	Dependent on the lands being acquired. Costs can sometimes be quite substantial

Examples

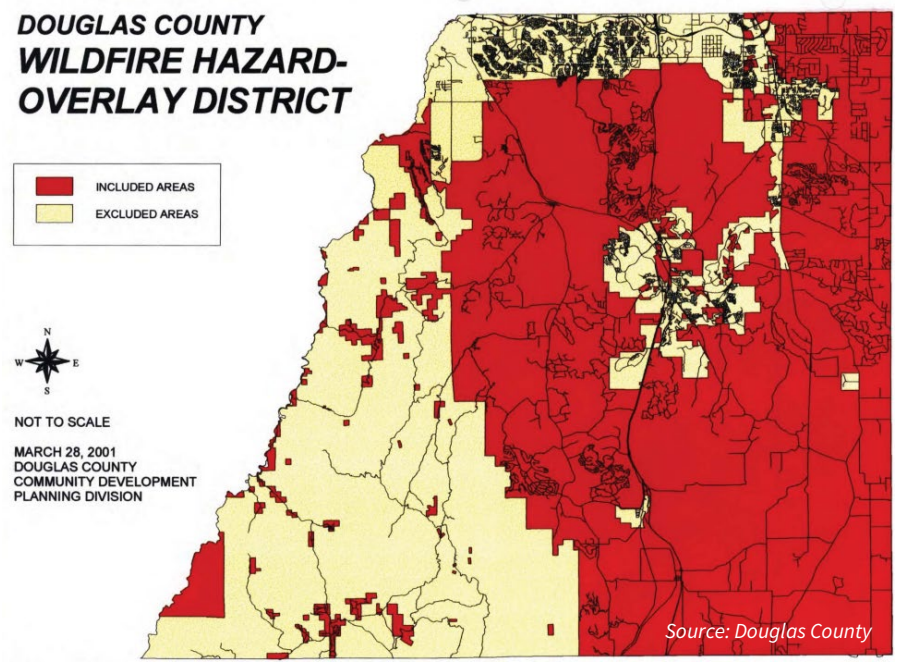
Boulder County Long-Term Recovery Group	bocofloodrecovery.org/ Also, see the County's Flood Recovery Resource Guide, including a description of the FEMA 404 "buyout" program here: bouldercounty.org/doc/flood/floodrecoveryguide.pdf
City of Boulder Open Space and Mountain Parks Department	bouldercolorado.gov/osmp/land-acquisition-program
City of Fort Collins Natural Areas Department	fcgov.com/naturalareas
Larimer County Open Lands Program	https://www.larimer.org/naturalresources/openlands

For More Information

Great Outdoors Colorado (GOCO)

http://www.goco.org/blog/what-conservation-easement

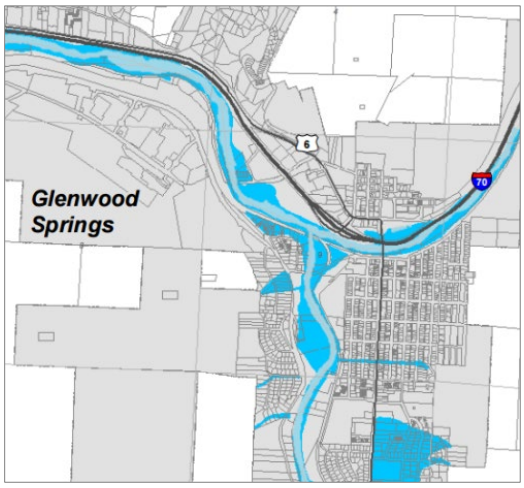
Overlay Zoning



Hazards Addressed:

How it Works

Overlay zoning is used by communities to apply area-specific standards and/or conditions. A **base zoning district** (such as residential or mixed-use) determines the types of uses permitted and the minimum dimensional requirements of lots and buildings. An **overlay district** (or overlay zone) applies an additional layer of standards to all areas within a defined overlay boundary, regardless of the underlying base zoning district. For example, an area with single-family homes that is zoned R-1 might also be within a hillside overlay zone. In this example, the permitted uses might allow construction of a single-family home according to the R-1 standards; however, the hillside overlay zone might prevent construction without first obtaining a geo-technical report.



Excerpt of the floodplain overlay from the Garfield County overlay districts map.

Source: garfield-county.com/geographic-information-systems/documents/zoning/OfficialZoneOverlays7536.pdf

Overlay zoning supplements or supersedes existing regulations within an underlying base zoning district. When drafting an overlay zoning district ordinance, consider whether all overlay zoning districts shall supersede existing zoning regulations, or if certain overlay zones should be treated differently. Some overlay zones (e.g., infill and redevelopment) are drafted to permit

exceptions or require a less-restrictive set of standards than otherwise provided in the zoning regulations.

For hazard mitigation purposes, overlay zoning is commonly applied to the following:

- **Floodplain management.** Regardless of the underlying zoning in place, areas that are subject to riverine flooding require special attention. Many communities use an overlay zone to apply floodplain regulations. Properties within this overlay are often subject to additional standards concerning land uses, building elevation, stream buffers, outdoor storage, building materials, and permitting procedures.
- **Hillside development.** Hillsides can be protected for both aesthetic and safety purposes. Hillside overlays often include additional standards to address natural features, steep slopes, viewsheds, and dangerous geologic conditions. These overlays can include provisions for special procedures, suitability analysis requirements, grading, landscaping, building height, and sometimes wildfire mitigation standards.
- **Wildland-urban interface.** Overlay zones also can be used to identify and protect areas subject to wildfire risk.

Implementation

To implement an overlay zoning district, many communities first prepare a study or report identifying a problem and linking the benefits of an overlay district to broader community policies or objectives in the comprehensive plan. Often, and particularly in the case of natural hazard mitigation, overlay zoning requires technical analysis and mapping (spatial definition) of the hazard boundary. The community then prepares the ordinance to include standards and procedures that apply to that defined overlay. As with other zoning code amendments, adoption of the ordinance requires approval by the governing body (City Council, Board of Trustees, or the County Commissioners). Overlay districts also can be amended, expanded, and lands reclassified through the rezoning process.

Where It's Been Done

Douglas County adopted a Wildfire Hazard Overlay District as part of their zoning resolution. The first item listed in the purpose statement for the district is "to develop and maintain a map of Douglas County that allows for preliminary identification of Wildfire Hazard Areas." The regulations and procedures within the overlay district not only apply to those included on the overlay map, but also any land areas field-verified as potential hazard areas. Within the overlay, land use applications must comply with general mitigation and forest management provisions, road and street design criteria, water supply provisions, and structural design elements.

In **Weld County**, the zoning ordinance includes a Geologic Hazard Overlay District. The district is intended to minimize hazards to people and property, especially related to geologic hazards. With assistance from the Colorado Geological Survey and the US Geological Survey, Weld County maintains a digital map delineating coverage based on previous studies related to underground coal mines (which could lead to subsidence). In this overlay, any special use

permit, planned unit development, change of zoning, or subdivision of land requires a geologic hazard overlay development permit prior to approval from the Board of County Commissioners.

Advantages and Key Talking Points

The primary benefit of overlay zoning is applying a unique set of standards to a specified area without having to amend all other relevant sections of the code. Other benefits include:

- Provides additional protection for defined hazard areas without negotiating on a case-by-case basis.
- Allows existing zoning regulations to be superseded or complemented to solve a known problem.
- Can implement comprehensive plan policies and strategies associated with future land use and the environment.
- Relatively easy to maintain over time following initial adoption.

Challenges

Overlay zoning often requires a higher level of technical expertise to administer. For example, enforcement of a floodplain overlay requires detailed knowledge of technical FEMA and NFIP requirements and other local building and engineering requirements. Other challenges include:

- Can require trained planning and engineering staff to develop the initial maps and standards.
- Adds an additional layer of requirements to the development review process.
- To mitigate natural hazards, requires fairly technical mapping of hazard area.
- Requires a zoning amendment, which requires formal action by the governing body.
- Requires that a community have a zoning ordinance in place, which may present a challenge to some smaller communities in Colorado without zoning.

Model Code Language and Commentary

Overlay zoning can be tailored to local conditions, which makes it an effective tool for addressing natural hazards. Overlay zoning typically is used in areas with flood, wildfire and geologic (steep slopes) hazards. The overlay zone district is often named for the type of natural hazard it is regulating, e.g., Hillside Protection Overlay or Floodplain Overlay District. Key elements of an overlay zone district include:

- Purpose
- Applicability
- Overlay district map
- Development standards

Commentary

Typical Hazards Addressed by Overlays: *The natural hazards most typically addressed with overlay zoning are flood, wildfire and steep slopes. Overlay zones can also be used to address other natural hazard risks or sensitive lands such as mapped avalanche zones, unstable soil conditions, dipping bedrock, wetlands or riparian corridors.*

- Review procedures

The following sections describe each of these common elements and provide standard language that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances from varying communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose

A. The purpose of the [*name*] Overlay District is to promote the public health, safety and welfare of the citizens of [n*ame of local government*]; minimize the risk of loss of life and property due to [*natural hazard*]; encourage and regulate prudent land use; permit only such uses that will minimize the danger to the public health, safety, welfare and property; reduce the demands for public expenditures for disaster relief, hazard mitigation, and protection of structures and facilities permitted in the underlying zone district(s); and regulate buildings and structures so as to minimize the hazard to the public health or property.

B. Furthermore the [*name*] Overlay District implements the following goals and policies of the [*name of local government*] Comprehensive Plan: [*relevant goals and policies*]

Purpose: *The purpose statement articulates the intent for the overlay district and identifies what is being regulated through the overlay standards. It should communicate why the overlay zone district was created and can identify the goals and objectives of local planning documents it is intended to implement.*

Applicability

A. The provisions and regulations of this section shall apply to all lands within [*name of local government*] designated a [*type of natural hazard/sensitive land*] as identified by the official map for the [*type of natural hazard/sensitive land*] Overlay District.

B. Uses permitted by the underlying zoning district are allowed unless specifically prohibited and provided that the proposed use complies with the standards and submittal requirements of this section.

C. All land use activities and development requiring a development, building, grading or other land use permit, are subject to the provisions of the [*type of natural hazard/sensitive land*] Overlay District as identified by the official map.

D. If a structure, lot, or other parcel of land lies partly within the [*type of natural hazard/sensitive land*] Overlay District, the part of such structure, lot, or parcel lying within the Overlay District shall meet all requirements for this district as set forth in this section.

Overlay District Map

The [*type of natural hazard/sensitive land*] Overlay District Map is hereby incorporated by reference and shall be maintained by the [*name of local government*] [*Planning Department*].

In cases where a boundary or the severity of conditions at a specific location within the Overlay District are disputed, the land owner of the property where the boundary is in dispute shall be given a reasonable opportunity to present their case to the [*Director of Planning or Administrator*] and shall submit technical evidence to support such dispute. The [*Director of Planning or Administrator*] shall not allow deviations from the boundary line as mapped unless technical and geological evidence clearly and conclusively establish that the map location of the line is incorrect, or that the designated hazard conditions do not present a significant hazard to public health, safety, or to property at the specific location within the hazard area boundary for the particular proposed land use.

Overlay District Map: *The natural hazard areas that are being regulated by the overlay zone district should be mapped based on reliable technical data. Official maps produced by state or Federal agencies, such as the Colorado Geological Survey or Federal Emergency Management Agency, can be adopted by the local government as official maps to define an overlay district. The maps need to be available for public reference at the local government offices and online if possible.*

Development Standards

This section should contain the substantive requirements that a proposed land use or development must comply with in order to meet the community's goals for the overlay zone district. This can include standards for building bulk, height, site layout, impervious surface area, specific construction methods, grading, vegetation and landscaping requirements, and special standards for public infrastructure such as roads and water systems.

Development Standards: *Identify possible development standards and narrow this list to those likely to be effective in the local community at achieving desired outcomes. The community may already have standards in existing development and engineering manuals that address steep slopes, soil conditions and flooding that can be made specific to natural hazard overlay districts.*

The required standards must directly relate to mitigating the risks posed by the natural hazard or the protection of sensitive lands.

A. General Standards

1. The provisions of this Overlay District shall apply in addition to the applicable requirements of the underlying zoning district. When the standards of this Overlay District conflict with any other provision of the [*code/ordinance*], this Overlay District shall control.
2. Development determined to be subject to the provisions of the [*type of natural hazard/sensitive land*] Overlay District shall be required to mitigate identified hazards through compliance with and utilization of the [*name of local government*] development standards listed below, and may require the implementation of a Mitigation or Management Plan specifically addressing the natural hazard conditions of the subject property.
3. Additional measures aimed at reducing the risk of [*type of natural hazard/sensitive land*] may be imposed at the discretion of the [*Chief Building Official or approval body*] for the type of development being proposed.

Mitigation Standards Manual: *Douglas County adopted a Wildfire Mitigation Standards manual that sets forth all requirements for site layout and building construction in its Wildfire Overlay Zone District. Adopting standards outside the zoning code allows the standards to be more easily updated as new construction techniques and fire-fighting methods are developed.*

B. Development Standards: All land use activity and development must comply with adopted [*name of natural hazard*] mitigation standards (such as floodplain regulations, or a hillside protection ordinance) in addition to the applicable requirements of the underlying zoning district. When these requirements conflict with any provision of the underlying zone district, the provisions of [*type of natural hazard/sensitive land*] Overlay District shall control. The types of mitigation measures required are as follows: (*Note: The model language below is an example for a wildfire hazard overlay zone district.)*

1. Wildfire Mitigation and Forest Management plan prepared by a professional forester, including but not limited to:
   a. Identification of fuel type as related to slope and aspect

   b. Reduction of fuel loading on-site
   c. Existing condition of current vegetation
   d. Recommendations to improve vegetative condition
2. Roads, streets and driveways designed for safe access for emergency fire equipment and evacuation.
3. Road, street, building, and emergency access signage designed for clear visibility from public roads.
4. Emergency water supply appropriate for the type and location of development proposed as determined by the [*Chief Building Official, Public Works Director, or Administrator*] in conjunction with the Fire Department.
5. All forms of development located, designed, and constructed in a manner to minimize ignition from a wildfire and the spread of fire from structures to wildland areas and/or structure to structure.

Submittal Requirements and Review Procedures

This section describes the submittal requirements and review procedures for the [*type of natural hazard/sensitive land*] Overlay District.

Submittal Requirements and Review Procedures: *Review and approval procedures for development in an overlay district should be concurrent with all other review processes required for the proposal.*

A. Submittal Requirements: These submittal requirements are in addition to the underlying zoning district submittal requirements for the type of land use activity or development proposed. The following information must be included in all applications for development or land use activity: (*Note: The model language below is an example for a wildfire hazard overlay zone district.)*

1. A description of the existing site characteristics including vegetative, topographical, and other pertinent environmental conditions.
2. A determination by a professional forester or qualified wildfire interface fire specialist as to whether the site characteristics constitute a hazard conducive to wildfire.

3. An assessment of the severity of the wildfire hazard and implications of future development relative to the protection of life-safety and resource protection.
4. An analysis of the intensity and character of existing and proposed development and its effect on the hazard.
5. An analysis of the relationship between the proposed development and the hazard both inside and outside the proposed development.
6. Recommendations pertaining to the form, type, and extent of required mitigation measures and how the proposed mitigation measures meet the standards and provisions of this Overlay District.
7. A site plan detailing the recommended mitigation measures incorporated into the proposed development.
8. A Hazard Mitigation or Management plan if determined necessary by the [*Planning Director*].

B. Review Procedures: The review procedure for the provisions of this Section will coincide with the review procedures for the type of development or use proposed and the requirements of the underlying zoning district.

1. Land use activity or development in the [*type of natural hazard/sensitive land*] Overlay District shall be determined based on the evidence and information required by this Section.
2. The approving body for the type of development application being processed in the [*type of natural hazard/sensitive land*] Overlay District shall approve, approve with conditions, or deny the requested development activity.
3. Additional conditions for approval may include, but are not limited to, the following:
   a. Alteration of the physical characteristics or vegetative features of the land;
   b. Construction standards required for proposed structures;
   c. Construction standards for roads;
   d. Design and density within the proposed development; and

e. Location of structures, uses, or other improvements within the proposed development.

Key Facts

Administrative capacity	Experienced planners with city or county attorney to write regulations and more advanced technical capability to administer the overlay requirements
Mapping	Technical mapping typically required to identify hazard areas
Regulatory requirements	Land use regulations with established zone districts
Maintenance	Minimal, but adjustments may be necessary to ensure overlay districts are appropriately meeting the goals of hazard mitigation over time
Adoption required	Yes
Statutory reference	C.R.S. §31-23-301
Associated costs	Ordinance development or amendment costs and staff time to review rezoning applications for approved development within the overlay zone district

Examples

Boulder County Natural Resource Protection and Floodplain Overlays	Sections 4-300 and 4-400 https://www.bouldercounty.org/transportation/floodplain-management/
Chaffee County Floodplain Overlay	chaffeecounty.org/EndUserFiles/57420.pdf Section 2.6.4
Douglas County Wildfire Hazard and Floodplain Overlays	douglas.co.us/documents/section-17-3.pdf douglas.co.us/documents/section-18.pdf
Garfield County Floodplain Overlay	garfield-county.com/community-development/land-use-regulations.aspx Section 3-301
Jefferson County Floodplain, Geologic Hazard, Wildfire Hazard, and Dipping Bedrock Hazard Overlays	https://www.jeffco.us/2452/Regulations-Plans Sections 30, 31, 32, and 33

City of Montrose Uncompahgre River Buffer Overlay	https://www.cityofmontrose.org/DocumentCenter/View/288/Zoning-Regulations?bidId= Section 4-4-8.3
Summit County Floodplain Overlay	http://co.summit.co.us/DocumentCenter/View/59/DEV4?bidId=
Weld County Geologic Hazard Overlay	https://library.municode.com/co/weld_county/codes/charter_and_county_code?nodeId=CH23ZO_ARTVOVDI_DIV2GEHAOVDI Article V, Division 2 of the zoning ordinance

For More Information

APA Zoning Topics

planning.org/divisions/planningandlaw/propertytopics.htm#Overlay

Stream Buffers and Setbacks

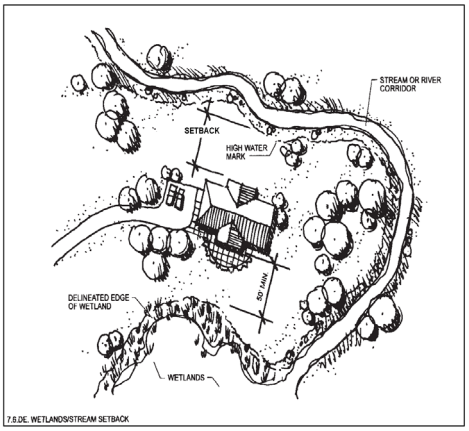
Source: Billy Hathorn

Hazards Addressed:

How it Works

A **stream buffer** (also known as a riparian buffer) is a defined area along a watercourse that is to be protected from development for the purpose of preserving the natural benefits of riparian ecosystems and reducing hazards risks of such areas. They are implemented in a similar manner and often in concert with buffers for wetlands and other sensitive areas such as tundra, steep slopes, and wildlife habitat. They are intended to protect the many functions (hydrologic, biological, ecological, aesthetic, recreational, and educational) that riparian areas provide to communities.

A **stream setback** is the minimum distance that a development must maintain between its boundaries and a riparian area to protect a buffer zone. Standard setback distances often range from 50 to 100 feet from the stream or river, but can vary based on the specific riparian zone. As a rule of thumb, a greater setback width means a greater margin of safety from water-related hazards. Both stream buffers and setbacks are used to limit or prohibit certain types (or all) development within them. They can differ from traditional floodplain ordinances – which typically focus on minimizing property damage by restricting development in a floodplain – by instituting additional restoration and ecological protection requirements within the buffer. In some



Estes Valley Colorado Development Code 7.6 Wetlands and Stream Corridor Protection

Source: Best Practices – Promoting Successful Mitigation in Colorado
dhsem.state.co.us/sites/default/attachments/WRP%20Appendix%20F%20-%20Mitigation%20Best%20Practices%20Guide.pdf

cases, restoration requirements – such as planting appropriate vegetation – are included as a condition for obtaining a development permit.

Stream buffers and setbacks function by limiting the amount of development adjacent to riparian and wetland zones to reduce exposure to flood risk and preserve the capacity of the buffer to minimize hazards through ecological processes. Additionally, such requirements can work by discouraging certain types of uses in these areas that could negatively impact water quality.

Implementation

Stream buffers and setbacks are implemented and enforced through local ordinance or codes. Generally, local requirements may be adopted either as part of a land use or zoning code, as stand-alone ordinances, or as part of other regulations (such as stormwater management regulations). Local governments take many different approaches to implementing stream buffers and setbacks. Some communities have fixed-width, non-varying setbacks for a variety of riparian areas (e.g., a 100-foot setback applies to all waterways). Other communities may adopt sliding-scale approaches with variable standards, based on different stream sizes and classifications and different types of land uses (e.g., certain intensive uses must be set back 100 feet, while less-intensive use must be set back 20 feet).

In addition, communities are authorized by statute to include provisions "establishing, regulating, and limiting such uses on or along any storm or floodwater runoff channel or basin as such storm or floodwater runoff channel or basin has been designated and approved by the Colorado Water Conservation Board (CWCB) in order to lessen or avoid the hazards to persons and damage to property resulting from the accumulation of storm or floodwaters." (C.R.S. § 30-28-111(1) and §31-23-301(1))

Where It's Been Done

Pitkin County enforces minimum fixed-width buffers of 100 feet from the high water line of a riparian or wetland area. Setback requirements can be reduced up to 50 feet if the applicant proves that a reduced buffer will not degrade water quality, contribute to stream bank erosion, or negatively impact the riparian or wetland habitat. Setback requirements in addition to the standard 100 feet may be required based on slope, soil, stream bank stability, proposed use of the property, 100-year flood zone boundaries, existing vegetation, flood and stormwater retention needs, or the presence of fish habitat or recreational amenities. In some cases, the Board of County Commissioners will determine that a setback of 150 feet or more is in the best interest of public health, safety, and welfare.

Some types of developments are exempt from setback requirements, like bridges, roads, trails, utilities, irrigation equipment, and flood control devices, if it is demonstrated that there is no alternative placement and disturbance to the buffer zone will be appropriately

mitigated. In general, Pitkin County requires damage to a buffer area from any development to be adequately mitigated through re-grading and re-vegetation.

Estes Park, and the surrounding **Estes Valley,** requires stream setbacks for all new development with the exception of some agricultural, maintenance, utility, habitat restoration, flood control, and recreational activities. Setback requirements in Estes Park depend on the type of waterway and the zoning classification of the area. The boundaries of streams and rivers from which the setbacks are measured are typically determined using the annual high water mark, defined banks, or the "thread" of the stream (the deepest groove or low water mark), depending on discernibility.

All buildings and accessory structures near a stream corridor, with the exception of those in the Commercial District zone, must be set back at least 30 feet, and those near a river corridor must be set back at least 50 feet. Parking lots must be set back 50 feet from both stream and river corridors. Within the Commercial District zone, structures must be set back by 20 feet from stream and river corridors, and parking lots must be set back by 12 feet. In most cases these requirements result in new construction being located outside of special flood hazard areas, and are credited with saving numerous structures from damage during the September 2013 flood event.

The City of Fort Collins determines the width of buffer zones based on the presence of ecological features, specific stream corridors, or the size of the wetland. Buffer widths range from 50 feet for isolated patches of riparian forest to between 100 and 300 feet for streams. An Ecological Characterization Study is required if a development site is within 500 feet of a natural feature, including wetland boundaries, and the top of bank, shoreline, and high water measurements of a perennial stream. This study informs the establishment of buffer zones to be included on project plans for development.

San Miguel County has fixed-width buffers of 100 feet. Any development within a buffer zone requires a Wetland Special Use Permit, which can be obtained if the development meets discretionary review standards. The land use code dictates restoration requirements for developers to restore wetland and riparian buffers to a functional condition if the ecosystem is altered or disturbed.

Advantages and Key Talking Points

Benefits of implementing stream buffers and setbacks include:

- Helps to preserve natural and beneficial functions of the floodplain.
- Protects the water course from the impacts of neighboring and upstream land uses.
- Helps reduce flood vulnerability both at the site as well as the surrounding area and downstream.
- Promotes habitat preservation of aquatic and adjacent riparian environments.
- Helps preserve water quality by limiting proximity of potential pollutants.
- Facilitates stream bank stability and reduces erosion potential.

Challenges

Some of the challenges associated with stream buffer and setback regulations include:

- Political will and community support is required to implement limitations on development location.
- Inability to implement along corridors where properties are already developed unless the property is destroyed or redeveloped.

Model Code Language and Commentary

In drafting and adopting riparian buffer and setback requirements, four issues should be considered:

- Purpose and intent
- Applicability and exemptions
- Development standards
- Procedures

Each of these is described in further detail below, including model language in blue shading for consideration. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances from varying communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Commentary

Location of Riparian Buffer and Setback Regulations: *Floodplain regulations are often included in zoning ordinances as a standalone chapter or article. They tend to be based largely on CWCB model regulations. Due to their length, specificity, and unique applications, they typically remain separate from other standards rather than being woven into other setbacks, use-specific standards, or permitting procedures.*

Purpose and Intent

This section should describe the jurisdiction's intent in adopting buffers, setbacks, and/or other riparian protection standards. Common purposes include:

A. To promote, preserve, and enhance the hydrologic, biological, ecological, aesthetic, recreational, and educational functions that stream and river corridors, associated riparian areas, and wetlands provide;
B. To identify flood hazards and avoid development within those flood hazards to the extent practicable;
C. To establish regulations seeking maximum protection of all waters of [*name of jurisdiction*];
D. To avoid development activity within [*buffer zones*];
E. To minimize the adverse impacts of development activity within [*buffer zones*];

Purpose and Intent: *The purpose and intent statement will vary depending on the types of watercourses and riparian areas the community is trying to protect. Communities should try to integrate established policies from the local hazard mitigation plan, the comprehensive plan, and other adopted policies and regulations where possible.*

F. To mitigate the impacts of development within [*buffer zones*];
G. To subject development within [*buffer zones*] to heightened review;
H. To prevent property loss and loss of life while ensuring the natural and unimpeded flow of watercourses; and
I. To encourage development and land uses that preserve existing watercourses as important natural features.

Applicability and Exemptions

Applicability standards describe when the riparian buffers and setback standards apply, and if there are any types of development activities or land uses that are exempt from the standards. The applicability section should include the following provisions:

A. The provisions of this [*chapter/article/section*] apply to all development within [*100 feet*] from the high-water line of the [*name of watercourse(s)*] and to all development within the 100-year floodplain.
B. This section shall apply to all new development, except for the following:
  1. The development does not add more than [*ten percent, or desired percentage*] to the floor area;
  2. No portion of the expansion, remodeling, or reconstruction will be closer to the high water line than the current development; and
  3. The expansion, remodeling, or reconstruction shall not constitute a substantial improvement in terms of a floodplain regulation, and shall not increase the amount of ground coverage of structures within the 100-year floodplain
  4. Maintenance and repair of existing public roads and utilities within easements or public rights-of-way;
    a. Maintenance and repair of flood control structures;
    b. Emergency response activities following a flood event;

Expansion, Remodeling, or Reconstruction: *Expansions of current structures or uses within designated floodplains or stream buffers require consideration of appropriate thresholds. For example, what if a roof needs replacement? What if a deck is proposed? What if the expansion is upward and does not expand the footprint?*

c. The expansion, remodeling, or reconstruction of an existing development provided the following standards are met.

Development Standards

Standards for riparian buffers and setbacks vary widely; however, general approaches to managing development within stream buffers include the following:

A. Development within the required buffer zone shall not be permitted unless the proposed development:
   1. Is required to provide protection against property loss and/or damage;
   2. Will improve the quality of the [*name or type of watercourse, or buffer zone*] and enhance the ecosystem by improving water quality, wildlife habitat, or biodiversity;
   3. Will not increase the base flood elevation on the parcel; and
   4. Will not pollute or interfere with the natural changes of the river, stream, or other tributary, including erosion and sedimentation during construction.

Development Standards: *Depending on the chosen standards, communities can apply them so that all standards have to be met or that a defined number of standards have to be met. For example, the community could state that "development shall not be approved in the buffer zone unless at least two of the following standards are met."*

B. There shall be no development below the top of slope or within [*15 feet*] of the top of slope or the high waterline, whichever is more restrictive;

Top of Slope Limitation: *This standard is developed to protect bank stability and riparian vegetation.*

C. No development or use shall be permitted that will disturb, remove, fill, drain, dredge, clear, destroy, or alter any area, including vegetation, within stream or river corridors, wetlands, or their associated [*buffer/setback areas*] unless expressly allowed by this [*code/ordinance*].

D. No fill material or debris shall be placed on the face of the slope in a stream buffer, and historic drainage patterns and rates shall be maintained;

E. Parking lots shall be setback a minimum of [*15 feet*] from the top of slope;

F. All buildings, accessory structures, and parking lots shall be setback a minimum of [*50 feet*] from the delineated edge of any wetland; and

G. If development in a [*buffer zone/setback area*] causes any disturbance within the [*buffer zone/setback area*], the applicant shall undertake restoration and mitigation measures such as regarding and revegetation to restore any damaged or lost natural resource.

Procedures

When development is proposed in areas where riparian buffers and setbacks apply, additional procedural requirements often apply. For example, a special use review application might not ordinarily require a grading plan; however, if the property contains a designated watercourse, then the community may require delineation of grades at two-foot contours. The specific procedural adjustments vary depending on the type of development and the type of approval being sought.

Procedures: *Approval procedures in a zoning code will likely already be defined in a separate administration and procedures chapter or section. These additional procedures would apply above and beyond those required for a development that is not subject to riparian buffers and setbacks. Additional procedures that apply in hazard-prone areas often build on and cross-reference the common review procedures that apply to all development applications.*

The following are examples of the types of supplemental procedures that may apply to development subject to riparian buffers and setbacks:

A. The development application shall include the following:
  1. Existing and proposed grades at two-foot contours;
  2. Proposed elevations of the development;
  3. Delineation of the high water line and the 100-year floodplain; and
  4. A description of the proposed construction techniques, including for grading, erosion, and sediment control.

B. The [*Director/Administrator*] may recommend and the [*Planning Commission/City Council/Board of County Commissioners, or equivalent*] may impose conditions to approval of an application with stream buffers and setbacks that include:
  1. Minimizing adverse impacts of the proposed development including the operation, type, and intensity of land uses;
  2. Controlling the timing of the proposed development;

3. Controlling the duration of use of the development and the time in which structures must be removed; and
4. Assuring that development is maintained properly over time.

Key Facts

Administrative capacity	Experienced planners with city or county attorney to write regulations and normal capability to administer the standards once adopted
Mapping	Mapping is strongly recommended. Can be coupled with open space, FEMA or floodplain overlay, or regular land use mapping
Regulatory requirements	Local regulations are generally adopted as part of land use or zoning codes or as part of other regulations (such as stormwater management regulations)
Maintenance	Minimal. Generally part of development review once regulations are adopted
Adoption required	Yes
Statutory reference	General land use authority is found in C.R.S. § 29-20-101. Colorado's "1041 Regulations" further describe the administration of natural hazard areas as they pertain to floodplains. These regulations are addressed in a separate model
Associated costs	Ordinance development or amendment costs and staff time to review development for compliance with regulations and monitor for enforcement

Examples

City of Aspen Environmentally Sensitive Areas and Stream Margin Review	https://www.cityofaspen.com/276/Title-26-Land-Use-Code Land Use Code, Part 400, and Section 26.435.040
City of Boulder Stream, Wetland, and Water Body Regulations	bouldercolorado.gov/plan-develop/stream-wetland-water-body-protection
Pitkin County River and Stream Corridors and Wetlands	https://pitkincounty.com/DocumentCenter/View/15539/chapter-07?bidId= Pitkin County Land Use Code Section 7-20-80

Town of Estes Park and Estes Valley Wetlands and Stream Corridor Protection	https://library.municode.com/CO/estes_valley/codes/development_code?nodeId=CH7GEDEST_S7.6WESTCOPR Estes Valley Development Code, Section 7.6
City of Fort Collins Natural Habits and Features and Establishment of Buffer Zones	https://library.municode.com/co/fort_collins/codes/land_use?nodeId=ART3GEDEST_DIV3.4ENNAARRECUREPRST_3.4.1NAHAFE Land Use Code, Division 3.4, and Section 3.4.1.E
San Miguel County Wetland Areas	sanmiguelcounty.org/DocumentCenter/Home/View/214 https://www.sanmiguelcountyco.gov/243/Land-Use-Code Land Use Code, Section 5-22

For More Information

Colorado Water Conservation Board: Watershed Protection and Restoration

cwcb.state.co.us/environment/watershed-protection-restoration/Pages/main.aspx

Conservation Tools.org

conservationtools.org/guides/119-riparian-buffer-protection-via-local-government-regulation

National Handbook of Conservation Practices: Conservation Practice Standard, Riparian Forest Buffer

nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026098.pdf

Protecting Stream and River Corridors: Creating Effective Local Riparian Buffer Ordinances

rivercenter.uga.edu/wp-content/uploads/sites/17/2015/03/Guidebook-for-Developing-Local-Riparian-Buffer-Ordinances.pdf

Improving Site Development Standards

Where zoning districts define appropriate locations for various land uses and/or building types (the "where"), site development standards describe the quality expected of development (the "how"). Site development standards address a wide range of issues:

- How the existing land is protected (e.g., floodplain regulation, open space and natural area protection);
- How the development site is laid out and planned (e.g., lot and block standards, circulation and connectivity, landscaping, parking); and
- How new buildings are located, designed, and operate (building dimensions, signage, lighting, and circulation and connectivity).

These standards can often impact a development's vulnerability to certain hazards. For example, landscaping standards might require a certain number of trees be provided on a lot, regardless of its location within the wildland-urban interface. Meeting the landscaping standards might conflict with defensible space standards. Reconciling these competing interests is where interdepartmental coordination is critical.

Tools that meet multiple community goals and objectives are often more supported by the community.

Like many other tools in this report, well-crafted site development standards can accomplish more than just mitigating hazards. For example, low-impact development helps communities reduce the risk of downstream flooding triggered by stormwater runoff, but also improves water quality. Also, subdivision regulations can help prevent densification in known hazard areas but also ensure orderly growth and development and support transportation investments. Tools that meet multiple goals and objectives are often more supported by the community.

This section explores tools that communities can use to improve site development standards to reduce risk or mitigate hazards. Tools profiled in this section include:

- Stormwater Ordinance
- Site-Specific Hazard Assessment
- Subdivision and Site Design Standards
- Use-Specific Standards
- Landscaping Ordinance

Enhanced Stormwater Management Techniques at the Watershed Scale

Traditional stormwater management practices are implemented at the local level. This is for good reason, as controlling the quantity and quality of runoff from land development is most effectively managed by applying site-specific techniques close to the source. ***Low-Impact Development (LID)*** *and* ***stormwater management Best Management Practices (BMPs)*** *embrace this concept and are appropriately designed for the individual parcel or lot level. However, regardless of approach, these management methods may still convey large volumes of stormwater to community drainage systems that are interconnected and only have so much capacity. Major rainfall events in particular will exceed this capacity and create flood hazards both at the site and downstream with stormwater overflows, backflows, and increased velocities with potentially destructive impacts to the built and natural environment.*

Watersheds *are larger areas of land where all water flows across or through and drains into a common stream, river, lake, or ocean. They include all the natural and structural channels designed to convey stormwater, the floodplains which store and transport floodwaters, and all other lands up to the highest elevation. No matter how they are delineated, all watersheds meet this definition and thus are critical for understanding and taking a holistic approach to stormwater and floodplain management. All communities are affected by development that takes place upstream in their watershed, and similarly will have an impact on downstream communities through their own development activity. Consequently, communities should plan on a watershed-wide scale.*

- *One of the first steps to implementing such an approach is the completion of a watershed master plan that assesses the potential impact of development on existing and future conditions – including impervious surfaces, drainage and stormwater flows, natural systems, and structures throughout the watershed. Plans should also assess the potential impacts to the community from larger rainfall events that exceed the performance standards (design storm) used for existing stormwater facilities.*
- *Once these impacts are known, a more comprehensive program can be created to prevent or minimize adverse impacts including new or revised regulations for development, enhanced macro-scale techniques for stormwater or floodplain management, or capital projects for flood control and mitigation. Such a program will help the community identify opportunities to address problems before and as they arise.*

In taking the watershed view, communities are better positioned to consider additional tools or strategies for risk reduction and avoid making development decisions that lead to increased flood hazard vulnerability. Watershed-based planning can also help facilitate regional or multi-jurisdictional coordination on stormwater and flood-related issues that traverse political boundaries. These enhanced efforts can lead to more integrated, coordinated, and systematic solutions across the watershed versus dealing with stormwater solely by locality. For example, by working with neighboring jurisdiction, communities may be able to consider the development and use of regional retention or detention measures. Pursuing these and other types of larger-scale projects may be used to leverage more non-traditional sources of funding for plan implementation. For these reasons, watershed-scale planning is often best executed at the regional scale, with coordination and creation of a regional planning entity with appropriate authority.

Stormwater Ordinance

Hazards Addressed

How it Works

Low-impact development (LID) and **stormwater best management practices (BMPs)** are common environmentally sensitive approaches to site development that minimize the adverse effects of stormwater runoff. They emphasize the use of site-specific design and other planning techniques to preserve natural systems. These may include both structural and non-structural measures to accommodate the infiltrating, filtering, storing, evaporating, and detaining of rainfall in proximity to where it falls. Structural measures are engineered solutions to reduce runoff through absorption and filtration such as vegetated buffers or swales, retention or detention basins, and permeable pavements. Non-structural measures include land use planning techniques that promote the use of natural features such as floodplains, riparian areas, and porous soils to reduce runoff while simultaneously limiting new impervious landscapes through site design. While a primary goal of LID and BMPs is to protect water quality and reduce flooding, they differ from conventional stormwater management strategies in that they also strive to minimize impervious areas and preserve or enhance the local landscape, habitat and ecological functions, aesthetics, public health, and other community assets or values.

Example of LID (bioswale) in large commercial parking area in Aurora, CO.

Source: Colorado Association of Stormwater and Floodplain Managers

LID and stormwater management BMPs include a broad range of practices for various

sites and development types, and can be applied to redevelopment or renovation projects as well as new construction.

LID practices are often development-specific, and include the conservation of open space, vegetation, wetlands, and other natural features, as well as the use of green infrastructure for lands intended to be developed or otherwise disturbed. **Green infrastructure** includes natural landscapes or facilities that seek to mimic natural functions. Examples include rain gardens, permeable pavements, cisterns, bioswales, vegetated infiltration beds, and green roofs – all of which are designed to capture and absorb, store, or use stormwater runoff, versus conveying it from the site.

Stormwater management BMPs are often managed by communities using a more holistic, systems-based approach with an emphasis on pollutant control and regulatory compliance. BMPs encompass a wide range of practices that are primarily intended to reduce or eliminate water quality impacts from stormwater runoff leaving a site. Examples include requirements for erosion and sediment control during construction and regulations for limiting post-construction runoff from the site, including LID and other design techniques for the on-site detention, retention, or treatment and conveyance of stormwater flows from impervious coverage.

Applied on a broad scale, LID and BMPs can maintain or restore a watershed's hydrologic and ecological functions and reduce the risk of downstream flooding triggered by excessive stormwater runoff that often accompanies community growth and urbanization. Additional hazard-related benefits include reducing an area's susceptibility to drought conditions through regenerative design measures such as water reuse and maintaining groundwater recharge.

Implementation

Requirements or incentives for applying LID and BMP approaches to site design can be incorporated into existing land development codes, stormwater management regulations, or erosion and sediment control ordinances. They can also be implemented in local public works projects. Communities typically implement LID or BMPs by regulating development on a case-by-case basis through site development standards that require the peak flow and volume of runoff from a site to be no greater than before it was developed. This may include a range of options or requirements for developers such as the use of structural BMPs for temporary stormwater detention or nonstructural techniques such as LID to maximize a site's ability to absorb site runoff. Communities must also specify certain criteria in the regulations such as the scale of development that is subject to the regulations and the performance standards (i.e., the design storm, which refers to a rainfall event of a specified frequency and magnitude) to be applied for facilities used to manage runoff from the site. The completion of hydrologic and hydraulic studies showing compliance with these standards is typically required of developers during site plan reviews.

Where It's Been Done

Since 2007 the **Southeast Metro Stormwater Authority (SEMSWA)** has worked in close partnership with the City of Centennial, Arapahoe County, and Douglas County to provide stormwater management services for drainage and flood control facilities. Created by a local intergovernmental agreement for a "drainage authority" in Colorado, SEMSWA operates as a political subdivision and a public corporation of the State. Per its mission statement, SEMSWA provides services "essential to the protection, preservation, and enhancement of our neighborhoods, community and natural resources through flood control, water quality, construction, maintenance, and education."

In addition to managing compliance with federal environmental regulations, SEMSWA reviews and approves various plans and reports for stormwater compliance through the planning and development process, including but not limited to land use cases, construction documents, drainage plans and reports, erosion and sediment control plans and reports, and floodplain development. They also plan and implement a variety of stormwater projects to ensure proper drainage, reduce flooding risks and property damage, and protect water quality. SEMSWA actively promotes the use of LID and stormwater BMPs for development projects throughout its service area, especially through minimizing impervious surface areas that are directly connected to the storm sewer system and maximizing pervious areas that receive stormwater runoff. Through its efforts SEMSWA has helped the City of Centennial, Arapahoe County, and Douglas County achieve among the highest credit scores in Colorado for stormwater management as assessed by FEMA's Community Rating System (CRS).

Wheat Ridge promotes the use of LID and stormwater BMPs through specific requirements that must be followed by all proposed developments or re-developments. The City's Site Drainage Requirements (2014) provide explicit information and guidance to development applicants that are based on the latest editions of the Drainage Criteria Manuals promulgated by the Urban Drainage and Flood Control District (UDFCD) and encouraged by the Colorado Association of Stormwater and Floodplain Managers (CASFM). This includes utilizing the UDFCD Four-Step Process that focuses on (1) reducing stormwater runoff volumes; (2) employing BMPs; (3) stabilizing drainageways; and (4) the implementation of long-term source controls. The requirements document includes clear descriptive language on the mandatory criteria and recommended practices for various development categories and activities, along with a series of flow charts to help applicants navigate the process with the City's Public Works Department.

Advantages and Key Talking Points

LID and BMP approaches to stormwater management provide communities and developers with flexible, cost-effective options for site design that maintain predevelopment volumes and rates of stormwater runoff. Other notable benefits include:

- Prevents future community development from increasing flood hazards to existing development.

- Helps maintain or improve surface water quality.
- Encourages small-scale designs for stormwater and water quality control that are tailored to specific site characteristics.
- Saves money:
    - The cost of LID is often less than the cost of conventional land development and stormwater management. Savings come from reduced costs for site preparation (clearing, grading, paving, stormwater infrastructure, etc.).
    - Reduces need for community infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewers, etc.). In fact, many property owners and homeowner associations perceive LID/BMP systems as value-added amenities and actively provide for their maintenance.
- Decreases the need for large stormwater detention areas or treatment plants, possibly enabling more land to be developed or used for other community purposes.
- Improves regulatory expediencies. LID and BMP practices are currently promoted by the Environmental Protection Agency (EPA) as a method to help communities meet goals of the Clean Water Act.
- Increases the ecological health of riparian stream corridors due to lower amounts of sediment and pollutants and/or decreased erosion due to stormwater velocity entering the waterway.

Challenges

Similar to other regulatory or capital project reviews for stormwater management, LID and BMPs often requires technical expertise to administer. For example, the review and enforcement of local regulations requires an engineer to review site plans, hydrologic and hydraulic studies, and other information demonstrating local compliance. Other challenges include:

- Requires that a community have stormwater management plans, regulations, and ordinances in place.
- Can be challenging to administer and enforce without trained staff.
- Adds an additional layer of requirements to the site plan or development review process.
- Requirements need to address the ongoing maintenance of LID or structures, which will become less effective over time without appropriate maintenance. Maintenance can be challenging for staff to monitor.
- Existing codes or regulations may prohibit or restrict the implementation of LID or BMP practices, requiring revisions or updates.

Model Code Language and Commentary

There are numerous options for how low-impact development and stormwater BMP standards may be integrated into a local government's various regulations. For example, they can be organized as a stand-alone chapter of a zoning and development code, or integrated into other site development standards (such as access and connectivity, erosion and sediment control, open space, and sensitive area protection). They also can be located outside the zoning regulations altogether, such as within technical engineering manuals, stormwater master plans, or other similar documents.

Wherever located in the regulatory framework, key issues to consider when adopting LID and stormwater requirements include the following:

- Purpose and intent
- Applicability
- Stormwater management site design standards

The following sections describe each of these elements and provide standard language that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances and programs from varying communities around the state and the nation, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Commentary

Cross-Reference Technical Standards: *Many zoning and land development codes simply cross-reference adopted stormwater management guidelines or criteria manuals.*

Purpose and Intent

Stormwater-related provisions may be found throughout a development code, whenever water quality issues are triggered. For example, consider the following purpose statement authorizing cluster development:

"This [*ordinance/section/etc.*] is intended to allow for the construction of [*residential/commercial/all development*] that promotes clustering arrangements. Flexibility is allowed in lot design in order to achieve alternative layouts than help preserve natural resources and allow for creative stormwater management solutions."

Or this more general purpose statement related to stormwater management:

This [*ordinance/section/etc.*] is intended to reduce the quantity of stormwater runoff generated, improve the quality of stormwater as it leaves a site, and increase the amount of onsite stormwater infiltration.

Purpose and intent statements should draw on applicable language from the comprehensive plan, if available. Comprehensive plans increasingly address issues like sustainability, resilience, and water quality that often include policies that support the development of LID code requirements and encourage the use of stormwater BMPs.

Applicability

A threshold decision for all communities is whether to encourage or require the use of LID principles and stormwater BMPs for new development. The more significant the stormwater issue in the community (hopefully documented in adopted plans), the more likely the community will mandate the use of LID and stormwater BMPs.

Categories of Development: *If categories of development are established, those thresholds can apply more broadly to the site plan review procedure and other development standards, not just for drainage or water quality. A community would not want to classify a "major" development differently within the context of drainage and water quality than it does for general site plan review procedures.*

Exceptions to general development standards should be considered for projects anticipated to have relatively low impacts on stormwater quality or quantity. For example, consider the following conditions for exemptions from LID or stormwater and water quality standards:

Exceptions to this [*ordinance/section/etc*.] include:

A. New single-family or two-family residential developments (or redevelopments) that are not part of a new subdivision and that disturb an area of less than one acre.

B. Parking lot maintenance of existing pavement, or replacement or removal of pavement of less than one-half acre with drainage patterns unchanged.

Applicability: *If required, the jurisdiction also must consider what types of development will be subject to the standards. For example, does all new development have to include LID elements? The general trend is increasingly to require the implementation of LID principles in most new development, particularly auto-intensive uses that have significant amounts of parking and/or other impervious cover.*

When establishing the applicability of stormwater requirements, many communities set thresholds and hold projects of different types to different standards. For example, new development can be categorized as minor development, moderate development, major

development, and/or redevelopment. Major development would include the most significant potential impacts to stormwater quantity or quality and would be subject to the most stringent regulations.

Stormwater Management Standards

Because of the importance of reducing the quantity of stormwater runoff, most communities that mandate any type of low-impact development establish a broad requirement that post-development stormwater runoff rates be the same as or less than pre-development rates. Beyond that basic requirement, there are a variety of opportunities for integrating LID and stormwater BMPs into development codes. The sections below discuss some of these options.

Require Onsite Stormwater Management

The treatment and retention of stormwater onsite is an important goal of most regulations. Communities can reduce the amount of runoff that leaves a site by adopting minimum onsite stormwater management controls, such as:

A. Development shall infiltrate [*90 percent*] of runoff through on-site management.
B. Development shall control either [*85 percent of a 24-hour storm runoff event*], or [*10 percent of the 50-year peak flow rate*] through landscape-based treatment to the maximum extent possible.
C. Development shall reduce urban runoff from all impermeable surfaces by [*0.75 inches*] using infiltration or treatment and release.

Impervious areas can be further reduced or "disconnected" by allowing methods for infiltration such as disconnecting downspouts, pavement disconnection (curb cuts), tree canopy increase, reducing impervious cover, and using green roofs or porous paving materials.

Dimensional Standards

Directly limiting impervious surface or building coverage can improve infiltration and vastly reduce total stormwater runoff. Consider the following:

In the [_____ *zoning district*], building coverage shall not exceed [*30 percent*] of the total lot.

Communities could also consider a system by which impervious coverage maximums are scaled to the size of the development, with more dense districts allowing for greater impervious coverages as shown in an example below.

Maximum impervious lot coverage shall not exceed the following percentages:

Size of Development Project	**R-1 district Low Density**	**R-2 district Medium Density**	**R-3 district High Density**
Less than 15,000 sf	50 percent	50 percent	60 percent
Between 15,000 sf and 49,999 sf	40 percent	50 percent	60 percent
Between 50,000 and 200,000 sf	25 percent	50 percent	60 percent
More than 200,000 sf	10 percent	50 percent	60 percent

The jurisdiction can adjust minimum lot sizes if necessary to accommodate LID and achieve permitted densities:

If compliance with [*LID standards/stormwater BMPs*] can only be achieved by increasing the amount of open space or landscaping beyond that otherwise required, the maximum residential density shall be calculated as though the additional required open space or landscaped area is developable land for dwellings, and the minimum lot sizes shall be adjusted as necessary to accommodate additional residential dwelling units permitted by that calculation.

Landscaping and Screening

Encouraging or requiring low-water and native landscaping can help create a more natural landscape and ultimately improve water quality and conservation efforts. Allowing for natural berms or screening materials other than walls can help improve drainage and reduce runoff. Some examples of integrating LID and stormwater BMPs into landscaping requirements are included below.

Incorporating LID into landscaping purpose statement:

The purpose of these urban landscape standards is to help support the creation of attractive places that reduce the negative impacts of an urban environment by:

A. Requiring canopies of tree-lined streets;
B. Requiring integration of xeriscape plant materials; and
C. Developing standards for public spaces.

Address future impervious areas added following a certificate of occupancy:

Following the issuance of the initial certificate of occupancy, if additional impervious area in excess of [*500 square feet*] is added to the site, open spaces and landscaped areas shall be revised to provide the required capture volume for the additional impervious area.

Parking and Loading

Reducing the minimum amount of required parking and loading areas can be one of the most impactful and effective techniques a local government can take to reduce stormwater quantity and improve water quality. Some communities establish parking maximums, and further establish that those maximums can only be exceeded if using LID principles such as porous pavers, or grass-lined swales within the parking design. Other communities are eliminating loading berth requirements to reduce runoff. For example:

Parking and Loading: *Parking standards require striking a balance between several competing interests. For example, reducing parking or setting parking maximums can result in improved water quality and reduced runoff; however, neighborhoods are often concerned with adjacent commercial parking inadequacies resulting in spillover onto residential streets.*

A. Maximum parking requirements can be exceeded up to [*ten percent*] if pervious pavement or pavers are used for the amount of parking in excess of the maximum parking requirements.
B. Retail sales and services with an aggregate gross floor area of less than [*15,000 square feet*] shall not be required to provide loading spaces.

Parking lot design should also be considered for incorporation of LID principles, such as:

A. Structured parking is required for some zoning districts or uses (thus reducing the per-space impermeable surface);

B. Landscaped swales are required between parking rows;
C. Breaks in curbs are required so that parking lot runoff flows into landscaped areas; and
D. Landscaped islands are required to break up large parking areas (such as blocks of 20 spaces or more).

Subdivision Design Standards

The layout and design of new subdivisions presents an opportunity to consider overall stormwater drainage and LID techniques (e.g., clustering lots to preserve greater opportunities for natural drainage and detention within the project). Consider alternative approaches to subdivision and circulation design, by implementing LID principles such as:

Subdivision and Site Design Standards: *Communities often include a separate section for subdivision design and site layout standards within a development standards chapter of the zoning code. Procedures related to subdivision approvals should be located with other development application approval procedures.*

A. Requiring alternative residential street layouts with narrower, open-section streets;
B. Limiting on-street parking to one side of the street where possible;
C. Incorporating bioswales and tree-lined streets;
D. Encouraging shared driveways for certain residential uses; and
E. Reducing minimum driveway widths.

Place the burden on the applicant to demonstrate why LID techniques could not be pursued under certain conditions:

For subdivisions where LID techniques are technically infeasible to meet stormwater quantity standards, the applicant shall provide a full justification and demonstrate why the use of LID techniques is not possible. In such case, LID stormwater management techniques shall still be used to meet water quality standards. Documentation of technical infeasibility shall include engineering calculations, geologic reports, hydrologic analyses, and site maps.

Green Factor: *Although rainwater harvesting is one of the encouraged LID techniques under the Green Factor program, it is not currently permitted under Colorado Law. Exceptions were made through House Bill 09-1129 to allow for pilot projects in select new developments to evaluate the feasibility of rainwater harvesting as a water conservation technique in Colorado.*

Incentives

Some communities encourage LID and stormwater BMPs through incentive programs and alternative or optional development standards, such as those described below.

Green Factor

Seattle, Washington, and subsequently Indianapolis, Indiana, adopted the "green factor," a performance-based landscaping system that encourages LID principles (and other benefits) by offering bonuses. Under the green factor, property owners are required to meet a minimum percentage parcel vegetation and can use various techniques to reach that threshold, including rainwater harvesting, drought tolerant plants, tree preservation, green roofs, and more. In Seattle, the green factor was originally limited to downtown business districts as a pilot program before applying it to other zoning districts.

To read more about the green factor in Indianapolis, see page 531 of the adopted Indianapolis Consolidated Zoning and Subdivision Ordinance, here:

indy.gov/egov/City/DMD/Current/Pages/ordinance.aspx

Green Alley Program

Chicago, Illinois, has implemented several green infrastructure incentive programs to encourage LID, including the "green alley" that began in 2006 to showcase pilot projects testing various permeable paving materials for use in alleys to both reduce flooding and increase infiltration of runoff. The city shares its best practices related to this program in the *Green Alley Handbook*, available here:

cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html

Xeriscape Rebate Program

Aurora, Colorado, offers rebates to its customers willing to replace high-water grass lawns to low-water use landscaping. Eligible areas include residential front and side yards, and commercial or large property areas that are highly visible to the public. Low-water use landscapes are eligible for up to $3,000 in rebates, and areas that require no supplemental watering following plant establishment are eligible for up to $4,500 in rebates. Learn more about the program, here:

auroragov.org/LivingHere/Water/Rebates/Xeriscape/index.htm

Key Facts

Administrative capacity	Water resource engineer or civil engineer
Mapping	Not required
Regulatory requirements	Stormwater management regulations; erosion and sediment control ordinance
Maintenance	Minimal
Adoption required	Yes
Statutory reference	C.R.S. §25-8 and Colorado Discharge Permit System Regulation 61.8(11)(ii)D)
Associated costs	Staff time for administration and enforcement

Examples

City of Aurora Zoning Ordinance and Xeriscape Rebate Program	Landscaping, Article 14. https://library.municode.com/CO/aurora Also see draft development standards in Module 2 https://www.auroragov.org/residents/code_enforcement/neighborhood_zoning_codes Xeriscape rebate program: https://www.auroragov.org/cms/one.aspx?pageId=3605519
City of Wheat Ridge Site Drainage Requirements	Site drainage requirements, at the bottom of the page under "resources" ci.wheatridge.co.us/64/Development-Review.
Southeast Metropolitan Storm Water Authority (SEMSWA), Colorado Stormwater Management Manual	semswa.org/semswa-stormwater-management-manual.aspx
Urban Drainage and Flood Control District (UDFCD), Colorado Stormwater Criteria Manual, Volume 3	udfcd.org/volume-three
City of Chicago Green Alley Program	https://www.chicago.gov/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html

City of Indianapolis, IN Green Factor in Zoning	https://www.indy.gov/activity/zoning-and-subdivision-ordinance-indy-rezone See page 531 of the adopted consolidated zoning and subdivision ordinance
Tri-County Regional Planning Commission, Central Illinois LID Residential Overlay Zoning Ordinance	https://tricountyrpc.org/

For More Information

Low Impact Development Center
lowimpactdevelopment.org

Colorado Department of Public Health and Environment, Water Quality Control Division
colorado.gov/pacific/cdphe/wqcd

Colorado Water Quality Control Commission
colorado.gov/pacific/cdphe/wqcc

Colorado Association of Stormwater and Floodplain Managers – Stormwater Quality Committee
https://www.casfm.org/about/committees/stormwater-quality-committee/

Colorado State University Stormwater Center
stormwatercenter.colostate.edu

Site-Specific Hazard Assessment

Source: K. Johnston

Hazards Addressed

How it Works

When hazards are potentially present on a site or are known through previous mapping efforts, the community should require a **site-specific hazard assessment.** This type of assessment requires a qualified professional with specialized knowledge of the particular hazard of which they are assessing. The appropriate professional (e.g., geotechnical specialist, civil engineer, wildfire mitigation specialist, certified forester, and certified floodplain manager) will consider existing state and/or local hazard maps; prior evidence of hazard history; and on-site features such as topography, soils, forests, water channels, and other structures to determine risk level of or to the proposed development. When applicable, communities may have a specific assessment form that is used to rate the hazard. This information will typically be compiled into a site-specific hazard mitigation plan that will require specific mitigation actions to be performed prior to or as a condition of approving the application or issuing a development permit, building permit, or a certificate of occupancy. This may include recommendations or requirements to adjust the land use, alter construction and building design, or utilize (or protect) surrounding environmental features to minimize the degree of hazard. This information will be provided to the developer, contractors, and/or property owner, and may be included in the planner's staff report for the planning commission or governing body.

Ultimately, the purpose of a site-specific hazard assessment is to identify hazards, determine a path for hazard mitigation, increase public safety, and reduce the threat of future property damage or loss of life.

Implementation

Requirements for when to require site-specific hazard assessments vary by jurisdiction and hazard. In some cases, the state may provide additional agency oversight, resources, or guidance as to when further site investigation is required for hazard mitigation, such as the oil and gas requirements for soils information and potential geological hazards. Local regulatory requirements are usually stated in the zoning code, subdivision code, building code, or a separate code (e.g., wildland-urban interface code).

Jurisdictions typically have flexibility in deciding when a site-specific hazard assessment is required. For example, a jurisdiction may choose to adopt a mapped hazard overlay zone that requires all new construction or retrofits within that zone to undergo a site-specific hazard assessment prior to granting development permit approval. Conversely, jurisdictions may find it more appropriate to require a site-specific hazard assessment for any permit, regardless of the location.

In any case, the applicability standards that trigger an assessment as well as the criteria for when and what type of mitigation is required should be clear. Planning staff should discuss this requirement with an applicant early in the development review process, such as at the pre-application meeting or when a sketch plan is first submitted.

Where It's Been Done

In 2003, **Eagle County** adopted wildfire regulations that require new development (special use permit, planned unit development (PUD), and subdivision) and new building construction or exterior remodels to comply with wildfire regulations. Development involving subdivision or PUD must include a vegetation management plan submitted with the sketch plan that provides an initial site-specific evaluation prepared by a natural resource professional with expertise in the field of vegetation management and wildfire mitigation. The vegetation management plan submitted with the preliminary plan is required to contain a more detailed site-specific analysis as indicated by the regulations.

Wildfire hazard assessments are required based on criteria stated above. Other interested property owners may also request a wildfire hazard assessment from Eagle County to reduce their property's risk. Assessments are either initiated via an online request form or by calling the wildfire mitigation staff coordinator. The county's qualified mitigation staff will conduct an on-site hazard assessment utilizing a customized assessment form (based on a national model assessment standard). The on-site field observations and assessment criteria are considered in conjunction with the county's wildfire hazard map to determine a site's specific rating. Based on the rating, the applicant will then be given a set of mitigation requirements prior to the county issuing a building permit. Mitigation requirements may include fuel management (e.g., removal of trees and/or other vegetation) and the use of fire-resistant construction materials, such as a Class A roof assembly, Class A rated decking materials, and non-combustible siding. The assessments are free, but building permits that require additional review and on-site follow up will be charged fees. Requirements are identified

early on in the process and publicly available on the county's wildfire mitigation website (*Wildfire Regulations,* 2003; *Overview,* 2015). **Boulder County** uses a similar approach to addressing their community's wildfire hazard (see Building Codes tool for more details).

The **Cordillera Community** in Eagle County takes their wildfire mitigation process one step further. They have their own local fire department that performs home assessments; every house is on a five-year rotation for re-assessment to ensure that vegetation is properly maintained.

The **Town of Vail** has adopted a requirement for a site-specific assessment for new construction and substantial remodels within avalanche hazard zones.

Advantages and Key Talking Points

- Site-specific hazard assessments are the best (and in some cases the only) way to identify hazards on a site and determine the most effective methods for mitigation.
- Assessments can highlight potentially hazardous conditions prior to any development occurring.
- Assessment approaches that facilitate staff and applicant interaction regarding appropriate hazard mitigation requirements provide an important educational component for discussing solutions to addressing known hazards.
- Results in reduced risk to property and life.

Challenges

- Site-specific hazard assessments require additional upfront time and resources for both the local government and the applicant. The process requires additional time to perform the assessment, create a mitigation plan, review the results with an applicant, and do a follow up site visit when necessary.
- A site-specific hazard assessment will also require specialized technical expertise that may result in additional costs borne by the applicant and/or local jurisdiction. If the local jurisdiction does not have qualified staff to perform the site-specific hazard assessment, consider maintaining a list of independent qualified contractors for referral.

Key Facts

Administrative capacity	High, requires technical expert
Mapping	Yes
Regulatory requirements	Yes, but varies by jurisdiction
Maintenance	N/A
Adoption required	Yes

Statutory reference	C.R.S. references relate primarily to general land use authority and administration and requirements for when site-specific assessments may apply, including but not limited to C.R.S. §§ 30-28-106, 30-28-133, 30-28-136, and 31-23-206.
Associated costs	Variable. Sometimes recovered by fees charged to applicant. Some fire districts may do these assessments for free

Examples

Boulder County Wildfire Mitigation	https://www.bouldercounty.org/disasters/wildfires/mitigation/
Eagle County Wildfire Regulations	eaglecounty.us/Building/Documents/Wildfire_Regs and eaglecounty.us/Building/Wildfire/Overview
Town of Vail Municipal Code	sterlingcodifiers.com/codebook/index.php?book_id=560 Chapter 21: Hazard Regulations

For More Information

American Planning Association

Zoning Practice, February 2005 Issue Number Two: *Practice Better Site Visits*. Stuart Meck.

American Planning Association Report Number 560

Hazard Mitigation: Integrating Best Practices into Planning. Provides additional examples of state legislation and local codes for site-specific assessments.

Model Code and Commentary

Site-specific hazard assessments are conducted by local governments and trained hazard mitigation experts on individual parcels on a case-by-case basis. They may be used to help inform various types of development applications, such as site plan review, conditional or special use review, or proposed subdivisions. Depending on the scope and scale of a proposed project, the recommendations stemming from such an assessment can vary widely. The recommendations depend largely on site-specific conditions and/or mitigation objectives that the community has defined relative to one or more hazards.

Because each assessment is unique, the principal drafting task involves preparing enabling language that provides the authority to conduct such assessments. The following elements should be considered when drafting ordinance language to authorize site-specific assessments:

- Purpose and Intent – Describes the purpose of the site-specific assessment, tailored to the hazards present in a community.
- Applicability and Exemptions – Establishes the types of development applications that are subject to a site-specific assessment. This section identifies the areas within which site-specific assessments will be required and the types of projects for which they are required (e.g., new construction, building expansion, and alterations).
- Procedures – This section establishes procedures for how site-specific assessments are conducted and the application submittal requirements. Some of the specifics related to administration of this procedure will likely be located outside of the land use regulations. See commentary at right.
- Definitions – This section defines key terms necessary to fully implement and administer a site-specific assessment procedure.

Commentary:

***Administration of this Procedure**: A site-specific hazard assessment procedure is not entirely administered through the land use code or zoning ordinance. Some communities have a separate set of checklists, criteria, and standards that live outside the ordinance in a handbook, developer's guide, or administrative manual that is used as a reference and is either distributed to the applicant or is available on the local government website.*

A developer's guide or administrative manual allows the local government to make modifications to submittal requirements, fees, and in this case the hazard assessment protocols without amending the code.

In Eagle County, Colorado, the wildfire mitigation specialist uses a handbook to determine the overall hazard rating of a parcel. The handbook includes an assessment of various conditions such as access, roofing material, defensible space, electrical service lines, and water supply. From that assessment, the County determines what types of mitigation must be met prior to issuing a Certificate of Occupancy (CO).

Each of these elements may be drafted as individual sections or subsections of an article or chapter within a development code.

The remainder of this model describes each element and provides standard language regarding hazard mitigation that may be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on existing ordinances and/or resolutions from several communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose

Establishing a clear purpose statement is essential to any development standard or procedure.

The purpose of this section is to:

1. Provide staff and the [*insert approval authority, e.g., Planning Commission, City Council, Board of County Commissioners*] with an understanding of a development site's specific constraints and distinguishing characteristics, especially as they relate to potential hazards;
2. Identify areas subject to site-specific hazards such as avalanches, landslides, rockfalls, mudflows, unstable slopes, floodplains, wildfire risk areas, or other environmental development constraints;
3. Avoid development in [*insert level of risk as it pertains to mapped hazard areas or other policies – e.g., high-risk or moderate risk*] areas;
4. Ensure that hazard risk is reduced or that development in hazard areas is appropriately mitigated;
5. Minimize impacts to environmentally sensitive areas; and
6. Protect the public health, safety, and welfare.

Purpose and Intent: *This section should list hazards and constraints that are commonly present in the community. Communities can also consider stronger language relating to avoiding development altogether in hazardous areas. Some communities choose to list individual purpose and intent elements (as in this example) instead of a single paragraph to improve user-friendliness.*

When stating any purpose related to risk reduction and hazard avoidance, it is important to consider adopted policies from the Comprehensive Plan or the Hazard Mitigation Plan and use similar terminology in the code.

Mapping: *Ideally communities will have accurate hazard maps available as the primary reference tool for determining when site-specific assessments are required. For more on mapping, see the sidebar on page 16 of the Planning for Hazards guide and a summary of data sources beginning on page 20 of the Planning for Hazards guide.*

Applicability and Exemptions

The applicability subsection should indicate which types of development applications (and in some cases, which specific geographic areas) are subject to site-specific hazard assessments. Communities with comprehensive mapping of hazard areas may opt to apply the procedure to multiple hazards, whereas other communities may only apply this procedure to flood or wildfire areas, for example.

Applicability: *Generally, the site-specific assessment should apply to any type of development that has the potential to further aggravate an existing hazard or place additional density in harm's way. Site-specific assessments should be applied to the extent possible given a community's capacity to administer and enforce the program.*

A site-specific hazard assessment shall be required for proposed applications for [*insert or list application types where site-specific assessments are required - e.g., rezoning, subdivision, conditional use permit, variance, minor or major site plan, master plan, PUD*] within the following areas:

A. Steep land with [*30 percent or greater*] slopes or unstable ground;

B. Land subject to geologic hazards such as landslide or rockfall;

C. Land within designated flood hazard areas pursuant to [*Section x.x (cross-reference floodplain regulations)*];

D. Land within wildfire hazard areas; and

E. Land with other environmental development constraints as identified by the [*Director, Zoning Administrator, or other authority*].

Exemptions: *Expansions and alterations are often allowed through streamlined procedures in modern codes. This encourages infill and redevelopment to occur without adding unnecessary process or expenses. However, at some point an alteration becomes big enough that exemptions may not be appropriate. Communities should select a standard definition of "major redevelopment" and apply that consistently throughout the code to the extent possible. For example, many communities identify a threshold for when new parking requirements apply to redevelopment projects; that same threshold should be considered for when a site-specific assessment is required.*

An exemption in this part of the code does not mean that some hazard concerns will not be addressed through other processes. For example, the building code will likely require certain improvements for fire protection, wind, and snow load regardless of whether a site-specific assessment is required.

Exemptions

Site-specific hazard assessments shall not be required for the following activities:

A. Maintenance and repair of existing public roads and utilities within easements or public rights-of-way; and

B. The expansion, remodeling, or reconstruction of an existing development so long as such expansion, remodeling, or reconstruction does not add more than [*e.g., 10 or 25 percent, or other desired percentage*] improved square footage and does not increase the amount of square footage within a hazard area.

Procedures

A site-specific hazard assessment is not a stand-alone type of development application; rather, it is a tool that provides information to inform another type of application. For example, an applicant for a subdivision plat may be required to conduct an assessment of potential hazards on his or her property to help ensure that new lots are not created in hazard areas. Similarly, a site-specific hazard assessment may be required as part of a site plan review to help ensure that development is not located on a portion of a lot that is potentially subject to flooding or another hazard-related threat. Because site-specific assessments may apply to multiple application types, the language describing them should be drafted as a common review procedure (see additional commentary at right), and then also cross-referenced in other sections of the ordinance that describe specific application types. For example, if site-specific assessments are required for both site plans and preliminary plats, the ordinance sections describing both of those procedures should include a cross-reference back to the site-specific hazard assessment procedure. Depending on local capacity, field visits and assessments may be conducted in-house, or otherwise delegated to external contractors at the expense of the landowner. See additional commentary in the margin.

***Common Review Procedures**: Many modern land development codes include a separate section for common review procedures, rather than repeating similar requirements for each type of development application. Common review procedures make future updates a more streamlined and consistent process by limiting edits to one location within the document rather than having to edit multiple application procedures.*

***Subject Matter Experts**: Similar to a pre-application meeting, for a site-specific hazard assessment it is imperative that the local government and partnering agency representatives attending the field visit are well-trained at assessing property for various hazard conditions. For example, in many communities the local fire district(s) conduct the site-specific hazard assessments for wildfire mitigation.*

Site-Specific Hazard Assessment Procedure

A. Pre-Application Determination (if required)

During a pre-application meeting, the [*insert responsible party or agency, e.g., staff, Planning Director, Town Administrator*] shall notify the applicant that a site-specific hazard assessment is required for any development listed in Section x.x. [*insert cross-reference to applicability section earlier in ordinance*].

B. Field Visit Scheduling and Attendance (in-house)

1. The applicant shall work with [*staff/jurisdiction*] to schedule a field visit prior to submitting an application.

2. The site being considered for development shall be visited in the field by the [*insert Planning Director and trained hazard expert(s)*] and other individuals or agencies deemed appropriate by the [*Planning Director, Town Administrator, etc.*].
3. The applicant shall attend the scheduled field visit.
4. At the [*Planning Director's, or other authority*] discretion, should inclement weather conditions limit the ability to adequately evaluate the site, the site visit may be rescheduled to a more favorable time and date.

C. Checklists and Criteria

Checklists for the types of conditions and mitigation requirements that are used to conduct a site-specific hazard assessment field visit shall be available at the [*Planning Department/City or County Website*] and shall be distributed to the applicant prior to the field visit. This section should mention the community's administrative manual or guidebook, if such document exists, as mentioned in the commentary on page 1.

D. Site-Specific Hazard Assessment

1. Prior to the field visit the applicant shall clearly mark the approximate location of proposed building envelopes and any other proposed structures such as [*decks, sheds, or outbuildings – tailor this list to match community requirements for building permits*].
2. During the field visit, officials shall communicate specific concerns related to hazards and other environmental development constraints to be addressed in a subsequent application submittal.
3. Field observations shall be documented and distributed to the applicant within [*five days, or more or less depending on capacity*].

E. Applicant Response to Assessment

1. The applicant shall address and respond to field observations in their application submittal to the maximum extent practicable and in compliance with this [*ordinance, code, etc.*].

In-House Assessment: *Depending on the types of hazards present on a site, the planning department (or whoever organizes the field visit) should assemble the appropriate team. If the property is in a flood hazard and a wildfire hazard area, then you may have the local floodplain administrator and the fire department present for the field visit.*

Externally Prepared Assessment: *Many communities do not have properly trained geologists, professional engineers, wildfire mitigation specialists, or other trained hazard experts on staff. For these communities, the assessment procedure should be tailored to require a field visit and an assessment report prepared by qualified contractors to be submitted to the local government as part of the development review process.*

Checklists and Criteria: *The Boulder County Wildfire Partners program offers a checklist for landowners to create and maintain effective wildfire mitigation.*

Sample assessment reports from that program are available here:

As another example, Eagle County outlines construction guidelines for development in wildfire areas as part of their wildfire mitigation assessments

2. The applicant shall make reasonable efforts to mitigate impacts of identified hazards and other environmental development constraints.
3. Results from the field visit may indicate that the hazard rating or environmental development constraints are minimal to the effect of not requiring additional mitigation beyond compliance with this [*ordinance, code, etc.*].

Key Definitions

In this model for a site-specific hazard assessment procedure, the following terms should be defined (if used in the local ordinance):

Development (option 1): Any man-made change to improved or unimproved real estate, including but not limited to the construction, reconstruction, conversion, or expansion of any structure; any change in use of a property, building, or structure; and any mining, dredging, filling, grading, paving excavation or drilling operation. The term "development" shall also include the act of subdivision.

Development (option 2): The construction of a building or structure, any clearing, grading, excavation or other movement of land, or the division of a parcel of land into two or more parcels.

Environmental development constraint: A natural environmental feature that typically precludes development, including but not limited to wetlands, steep slopes [*insert what defines a steep slope in the community, e.g., 20-30 percent*] or greater, floodplains, and areas subject to geological hazards (rockfall, mudslide, avalanche, etc.).

Maximum extent practicable (option 1): Under the circumstances, reasonable efforts have been made to comply with the regulation or requirement, that the costs of compliance clearly outweigh the potential benefits to the public or would unreasonably burden the proposed project, and reasonable steps have been undertaken to minimize any potential harm or adverse impacts resulting from noncompliance.

Maximum extent practicable/feasible (option 2): That no feasible and prudent alternative exists, and all possible efforts have been made to comply with the regulation or minimize potential harm or adverse impacts.

Subdivision and Site Design Standards

How it Works

Subdivision and site design standards are used by communities to regulate how parcels of land are divided into developable lots, and how those lots are subsequently designed and laid out through the development process. Subdivision typically includes the creation of a sketch plan (showing basic lot layout and provisions for public infrastructure), and subsequent creation of a more detailed preliminary plat (indicating building footprints and specific measurements), and then culminating in a final plat that creates the new lots. Abbreviated procedures are typically established for minor subdivisions that involve the creation of just a handful of lots.

Site design standards are related and define the basic parameters for development on individual lots, including maximum or minimum lot size, how buildings are situated on a lot, traffic and circulation patterns, pedestrian connectivity, preservation of open areas, and avoidance of hazardous areas.

Communities increasingly consider hazard mitigation when adopting site layout standards. For example, applicants are required to avoid mapped hazard areas (like floodplains) in new development or to develop strategies to mitigate the hazard risk.

Implementation

As communities grow, they should identify where new growth should be concentrated through long-range planning mechanisms, such as the comprehensive planning process. There can be pressure to locate new development in areas that are known to be at risk from

hazards. Communities must balance competing interests when reviewing proposed development. For example, the need for additional workforce housing in a community should be balanced against the desire to protect natural areas, view corridors, and natural hazard areas, as well as the safety and welfare of future inhabitants of the development. Communities are challenged with keeping development out of harm's way while allowing individuals to develop land consistent with stated policies. Communities can often find middle ground through subdivision standards that allow for new subdivisions to be approved when they meet conditions to mitigate hazards, such as water cisterns for wildfire protection, slope stabilization for landslide and rockfall, and keeping buildable lots out of the floodplain. Additional incentives and regulations can be explored such as **cluster subdivisions**, **density bonuses**, and **Transfer of Development Rights (TDRs)**, each of which are good tools for promoting avoidance of hazards. Each of these are discussed in separate planning tool profiles.

According to APA's *Zoning Practice* issue on Safe Growth Audits (*Godschalk*, 2009), communities should ask themselves the following questions related to their subdivision regulations:

1. Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?
2. Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?
3. Do the regulations allow density transfers where hazard areas exist?

As with zoning codes, adoption of subdivision ordinances or site design standards requires approval by the governing body (City Council, Board of Trustees, or County Commissioners).

Where It's Been Done

Pagosa Springs adopted sensitive area protection standards for subdivisions and for redevelopment of existing areas in its *Land Use and Development Code* (2015). The standards generally address the following issues:

- **Slopes.** Slopes greater than 30 percent, or otherwise unstable or subject to hazards, are not allowed to be platted or developed for residential uses without mitigation controls in place.
- **Natural Features.** Subdivisions or development shall protect waterways, vegetation, and rocks and other natural features or vistas.
- **Areas of Special Flood Hazard.** Mapped special flood hazard areas identify areas where subdivisions shall not be approved without evidence that it is not in a flood hazard or meets other flood damage protection regulations to the satisfaction of the floodplain administrator.
- **Geologic Hazard Areas.** Subdivisions and site plans must meet mitigation conditions prior to approval in mapped geologic hazard areas in the Town as the information becomes available, including provisions to prevent danger to human life or property.

- **Wildfire Hazard Areas.** Applicants for subdivisions or other development must provide evidence from a professional forester that the proposal meets several conditions, including adequate roads for emergency services and criteria for wildfire areas published by the Colorado State Forest Service.
- **Perimeter Fencing.** Limits the height to protect migration of elk and deer.
- **Riparian Setbacks.** To promote and preserve the quality of the river ecology, aesthetic, and recreation.

In addition to these standards, approval criteria for major subdivisions also address areas that may involve soil or topographical conditions that present hazards.

Similarly, **Park County** has adopted a dedicated set of natural resource protection standards in its development code that address steep slope protection; ridgeline protection; drainage, erosion, and sedimentation control; irrigation and mining ditches; wildlife habitat; and geologic and wildfire hazards. The latter section incorporates approaches that are common in Colorado communities. It provides that:

On US24/285 in Park County, CO.

Source: Ken Lund

- Land uses are restricted to geologic and wildfire hazard-free areas if such areas exist on a site.
- If no hazard-free area exists on a site, the diversity of uses and permitted residential land use densities may be limited to minimize potential dangers to persons or wildlife.
- Land use applications shall be denied if the Board of County Commissioners finds that site planning and engineering techniques cannot reasonably mitigate potential hazards to public health, safety and welfare; land use shall also be prohibited if it subjects persons or the County to dangers or expenses required to mitigate hazardous conditions to respond to emergencies created by such conditions, or to rehabilitate improvements and lands (*Use and Development Standards*, 2014, p. 23).

Advantages and Key Talking Points

In terms of hazard mitigation, the primary benefit of adopting effective subdivision and site design standards is to ensure that new development occurs in a high quality, well-designed manner that avoids potential high-hazard areas, in addition to meeting other important community goals. Other benefits include:

- Effective at managing new development in growing communities. Clearly defining hazard areas allows elected officials to say no to new development in unsafe areas.
- Provides additional protection for defined hazard areas without negotiation on a case-by-case basis. Approval criteria can be stated in the code, making expectations clear to the developer and the decision makers.

- Can be tailored to fit a common set of review procedures. Adding natural hazards as a component of existing subdivision regulations can be done relatively easily through an ordinance amendment.
- Relatively easy to maintain over time, following initial adoption.

Challenges

As is the case with many planning tools, subdivision and site design standards that address hazard mitigation must also strike a balance with other community objectives and private property rights.

- To mitigate natural hazards, a fairly technical mapping of hazard areas is required. Identifying hazard areas can be costly, and keeping mapped areas up-to-date following successful mitigation measures requires a continual maintenance program.
- Requires a land use code amendment, which requires action by the governing body.
- Geared toward new development, and has little ability to address existing development in hazardous areas.

Model Code Language and Commentary

Subdivision regulations typically cover lot and block design, street design and improvements, drainage easements, layout of utility systems, and water distribution systems. Site design standards address a wide variety of site-specific design and operational issues such as parking (lot layout, location, and design), landscaping, exterior lighting, and trash enclosures. Key elements related to subdivision and site design that specifically address natural hazards include:

- Suitability of land for subdivision;
- Subdivision improvement agreements;
- Standards for natural hazard area mitigation, including but not limited to flood hazard, geologic hazard, and wildfire hazard; and
- Cross-references to zoning, site development, and subdivision requirements.

Commentary

The following sections provide example language for each of the common elements. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances and programs from varying communities around the state, including municipalities and counties. The language is illustrative

only; consult local counsel to tailor language for your jurisdiction.

Suitability of Land for Subdivision

Subdivision regulations often specifically prohibit the subdivision and subsequent development of land found to have or be subject to natural hazards. This prohibition often is included in the general design standards of the jurisdiction's subdivision regulations.

Suitability of Land for Subdivision: *Some subdivision codes contain standards for natural hazards mitigation or sensitive area mitigation. The Teller County subdivision regulations have a "Site and Development Goals, Objectives, and Guidelines" table stating design requirements for geologic, fire, flood and slope hazards.*

Suitability of Land for Subdivision: Land subject to natural hazards such as flooding, wildfire, falling rock, landslides, and avalanches shall be considered unsuitable for any occupancy that may impair the health, safety, or welfare of the inhabitants. Such land shall be identified and shall not be subdivided until the hazards have been mitigated or will be mitigated by the subdivision and construction plans in accordance with the Sensitive Area Protection Standards of this Land Development Code. Where such hazardous conditions are adjacent to lands proposed for subdivision, the proposal may be denied unless potentially hazardous conditions are appropriately mitigated per this Code.

Subdivision Improvement Agreements

Land that is subject to hazardous conditions may need specific mitigation improvements that will be completed pursuant to a Development or Subdivision Improvement Agreement. The terms of this agreement should specify the work that will be completed and time-frame for completion. The long-term maintenance of such improvements will need to be identified in that agreement, as well. This agreement will need to be accepted by both the developer and the governing board of the local jurisdiction. As well, the developer will need to post a bond or letter of credit sufficient to complete the improvements as specified in the agreement.

If land with hazardous conditions is to remain undeveloped within the subdivision, an easement or deed restriction should be recorded specifically restricting its development and use based on the conditions posed by the natural hazard. The subdivision plat should specifically show the area to be restricted

from development and reference the recorded easement or deed restriction.

Sensitive Area Protection Standards

A. Purpose: Certain areas of [*name of local government*] contain natural resources that contribute to the [*name of local government*] character, such as waterways, wetlands and drainages, wildlife habitat, viewsheds, and hillsides. There are also certain areas that may pose hazards to property, infrastructure, and public safety because of natural hazard conditions on or adjacent to buildable lots, including flooding, geologic conditions, wildfire hazard, or soil conditions. The standards of this section are intended to ensure that environmental features are protected, the natural character of [*name of local government*] is maintained, and development on potentially hazardous lands protects inhabitants and minimizes environmental and aesthetic impacts.

B. General Site Design: Developments shall minimize impacts to sensitive natural resources, natural hazards, and other unique and fragile site elements including but not limited to wetlands, open space, and steep slopes. Such resources and features shall be preserved where practicable. Subdivisions and any development shall be designed to preserve existing waterways (lakes, rivers, and streams), primary vegetation (trees), rock formations, and other natural vistas, as well as other environmental resources and features.

C. Slopes: Steep land (30 percent or greater slopes), unstable ground, and land subject to hazards such as landslides, rockfall, ground subsidence, wildfire, or flooding shall not be platted or developed for residential or other uses that may endanger life and limb or habitable improvements, unless appropriate provisions, as deemed necessary by the [*Building Department*], are made to eliminate or control the hazard.

D. Natural Features: Subdivisions and any development shall make every effort to preserve

Suitability of Land for Subdivision: *Some subdivision codes contain standards for natural hazards mitigation or sensitive area mitigation. The Teller County subdivision regulations have a "Site and Development Goals, Objectives, and Guidelines" table stating design requirements for geologic, fire, flood and slope hazards.*

Sensitive Area Protection Standards: *These are site layout/design standards similar to other required site design standards applicable to all development, whether in a new subdivision or a redevelopment/re-use of property on previously subdivided land. They are typically included in the jurisdiction's code and generally applicable to development and design standards since they are intended to apply to projects where subdivision may not be required, as well as new subdivisions.*

Steep Slopes and Natural Features: *Areas of particular sensitivity should be listed based on local environmental hazard assessments. In the model code example, two types of sensitive features are included: one to illustrate a natural hazard condition (steep slopes) and the other to describe an example of important local characteristics (natural Features). Local communities could identify other important visual and ecological features for protection under this section, as well as natural hazards.*

existing waterways (lakes, rivers, and streams), primary vegetation (trees), rock formations, and other natural vistas.

E. Flood Hazard Areas: The [*Planning Department*] shall keep on file and available to the public a set of maps showing all known and identified areas of special flood hazard in [*name of local government*]. A subdivision or development in a special flood hazard area shall not be approved unless adequate evidence, prepared by a registered professional engineer, is submitted that shows the proposed subdivision or development is not in an area of special flood hazard or that the conditions of Section [*X.X*], Floodplain Regulations, will be met.

F. Geologic Hazard Areas: The [*Planning Department*] shall keep on file and available to the public a set of maps clearly showing all known and identified geologic hazard areas in the [*name of local government*], as such become available. [*name of local government*] shall not approve any subdivision plan or site plan if the proposed subdivision or development is either in one of these identified geologic hazard areas or is in an area suspected of being in a geologic hazard area, unless the applicant can submit adequate evidence, prepared by a registered professional geotechnical engineer, that the proposed subdivision or development meets the following conditions:

1. Provisions have been made for the long-term health, welfare, and safety of the public from geologic hazards to life, property, and improvements;
2. The proposed development will not create an undue financial burden on the existing or future residents of the area or community as a result of damage due to geologic hazards;
3. Structures designed for human occupancy or use will be constructed to prevent danger to human life or property;
4. Permitted land uses, including public facilities serving such use, will avoid or mitigate geologic hazards at the time of initial construction; and

Preliminary Plat Review by Technical Experts: *Counties are required by state statutes (C.R.S. §30-28-136) to submit preliminary plats to the Colorado Geological Survey for an evaluation of those geologic factors that would have a significant impact on the proposed use of land, and to the Colorado State Forest Service and local conservation district to review of wildfire, soil suitability, and any potential flooding issues.*

5. Man-made changes will not initiate or intensify adverse natural conditions within a geologic hazard area.

G. Wildfire Hazard Areas: The [*Planning Department*] shall keep on file and available to the public a set of maps clearly showing all known and identified wildfire hazard areas in the [*name of local government*], as such become available. The [*name of local government*] shall not approve any subdivision plan or site plan if the proposed subdivision or development is in an area identified as a wildfire hazard area or is in an area suspected of being in a wildfire hazard area, unless the applicant can submit adequate evidence, prepared by a qualified professional forester, that the proposed subdivision or development meets the following conditions:

1. Any development in which residential activity is to take place shall be designed to minimize significant wildfire hazards to public health, safety, and property;
2. Any development will have adequate roads for emergency service by fire trucks, firefighting personnel, and fire breaks or other means of alleviating conditions conducive to wildfire hazard;
3. Precautions required to reduce or eliminate wildfire hazards will be provided at the time of initial development;
4. All subdivision and development will adhere to the Guidelines and Criteria for Wildfire Hazard Areas published by the Colorado State Forest Service; and
5. Consideration of recommendations of the State Forest Service resulting from review of a proposed subdivision or development in a wildfire hazard area.

Hazard Areas: *Teller County uses a table format in its subdivision regulations that details design guidelines for specific objectives related to geologic, fire, flood and slope hazards. These guidelines must be met for a subdivision to be approved. The guidelines include use of building techniques, such as use of fire retarding roof and exterior wall materials to mitigate wildfire hazard, as part of a subdivision requirement.*

Key Facts

Administrative capacity	Experienced planner
Mapping	Mapping should be completed to identify areas subject to special standards
Regulatory requirements	Zoning and/or land development regulations
Maintenance	Minimal
Adoption required	Yes
Statutory reference	C.R.S. §30-28-133; §30-28-136; §31-23-214
Associated costs	Staff time for drafting and adoption process

Examples

Town of Pagosa Springs Land Use and Development Code	https://library.municode.com/co/pagosa_springs/codes/code_of_ordinances?nodeId=CH21LAUSDECO_ART6DEDEST_6.4SEARPR Section 6.4
Park County Land Use Regulations	parkco.us/189/Land-Use-Regulations Article VII, Division 6: Natural Resource Protection
San Miguel County Land Use Code	https://co-sanmiguelcounty-old.civicplus.com/DocumentCenter/View/211/Article-2---Land-Use-Policies-PDF?bidId= Section 2-8
Summit County Subdivision Regulations	http://co.summit.co.us/DocumentCenter/View/58/DEV3?bidId= Sections 3202.02 and 8101
Teller County Subdivision Regulations and Critical Areas Regulations	co.teller.co.us/CDSD/Planning/LandUseRegs/CH 09 subdiv ADOPTED.pdf (pg. 64-66) and http://www.co.teller.co.us/cdsd/planning/LandUseRegs/CH%2006%20critical%20areas%20ADOPTED.pdf

For More Information

APA's "Practice Safe Growth Audits"

planning.org/nationalcenters/hazards Safe Growth Audits located near bottom of page, under resources.

Use-Specific Standards

Source: Clarion Associates

Hazards Addressed

How it Works

Use-specific standards are used by communities to place limitations on, or apply conditions or specific standards to, certain land uses. Use-specific standards are an effective strategy for neighborhood protection, resource protection, and risk avoidance. Use-specific standards are adopted by ordinance as part of the zoning code, but the complexity and organization of these standards varies widely across communities. As with many other zoning tools, use-specific standards can be calibrated to serve a particular purpose (such as hazard mitigation), can apply to some or all zoning districts or subareas, and can be linked to one or multiple land uses. Communities commonly apply use-specific standards to potentially problematic land uses such as liquor stores, late-night uses, pawn shops, and marijuana facilities. Such uses often come with specific challenges, such as perceptions of increased crime or traffic. Use-specific standards might require limited hours of operation, added security measures, or limiting the number of such uses within a geographic area.

For hazard mitigation purposes, use-specific standards can be applied to any use that has the potential to create or exacerbate a known hazard. One example could be to require industrial uses that store explosive materials to be set back an additional distance from residential areas. An example of the need for such setbacks occurred in April 2013 in West, Texas, when an explosion at a fertilizer storage and distribution facility resulted in 15 deaths, hundreds injured, and more than 150 buildings damaged or destroyed, due in part to the fact that the factory was located too close to residential neighborhoods, including an apartment building and nursing home.

Storage of explosive materials is one example where use-specific standards can establish safeguards against potential accidents or spills. In this example, industrial storage might be a

permitted use in a particular zoning district, but the use-specific standards would indicate that storage of explosive or hazardous materials triggers additional criteria that must be met in order to proceed with that use. Those criteria might include distance requirements from residential areas, sign-off from local fire and building safety officials, and/or additional public hearings for approval (as a conditional or special use).

Use-specific standards also can be helpful in addressing other types of hazards, beyond storage of hazardous materials; for example, setback requirements can provide buffer zones from areas prone to avalanche, flood, or landslide. They could also be used to help mitigate potential fire danger in the wildland-urban interface (WUI).

Implementation

A typical zoning code will describe the types of uses permitted within each zoning district and reference any additional standards that apply to that use. Communities should consider the following when developing new use-specific standards:

- Define the purpose for the use-specific standard. Is the standard necessary to protect people or property from hazards? Is it connected to other community-wide goals or policies?
- Define the areas where the use-specific standard applies. Should the additional standard apply to certain zoning districts or subareas? Should it apply to any parcel that proposes that particular land use?
- Articulate the minimum standard required to mitigate the problem. Determine whether the standard can be reviewed for compliance without a public hearing.
- Is the standard enforceable given current community resources?

Once the standards have been adopted, they should be integrated into the existing zoning regulations either in a dedicated section or throughout the applicable sections that relate to a particular use. Most codes today include a permitted land use table indicating which uses are permitted by district. That table can include cross-references for any applicable use-specific standards.

Several federal laws preempt local zoning authority when it comes to regulating specific uses, including telecommunications, signs, religious institutions, and individuals covered under the Federal Fair Housing Act. State licensing regulations may also apply to certain uses, such as group homes. Communities sometimes simply defer to federal and/or state laws when developing use-specific standards for those types of uses, but sometimes do have the ability to regulate above and beyond minimum standards established at the federal and/or state level.

Where It's Been Done

Durango applies use-specific standards to dozens of allowable uses. In particular, heavy industry must comply with use-specific standards such as limited parcel areas for proposed development, additional setbacks, limitations on outdoor storage, and requirements for a

truck routing plan (for hazardous materials). Durango's permitted use matrices make it clear to the reader which land uses are required to meet additional use-specific standards (*Durango Land Use and Development,* 2014).

Table 2-1-3-8
Industrial, Wholesale, and Solid Waste Processing and Recycling Uses

Land Use	Standards Reference [1]	Zoning Districts: Residential					Mixed-Use			Nonresidential				Rural and Open Space		Public and Planned	
		EN-#	EN-MF	RL	RM	RH	CB	MU-N	MU-A	CG	CR	BP	LI	RA	OS	PB	PD
Industrial and Wholesale Uses																	
Brewery / Distillery / Winery	§ 2-2-3-16	-	-	-	-	-	-	-	-	-	-	S	A	-	-	-	A[2]
Extraction, Coal, Gravel, Minerals, or Sand	§ 2-2-3-16	-	-	-	-	-	-	-	-	-	-	-	C	C	C	-	A[2]
Extraction, Minor Oil and Gas Facility	Division 4-4-10	-	-	L	L	L	-	-	-	L	L	L	L	L	L	L	A[2]
Extraction, Major Oil and Gas Facility	Division 4-4-10	-	-	C	C	C	-	-	-	C	C	C	C	C	C	C	C
Heavy Industry	§ 2-2-3-16	-	-	-	-	-	-	-	-	-	-	C	L	-	-	-	A[2]
Light Industry	§ 2-2-3-16	-	-	-	-	-	-	-	-	-	L	A	A	-	-	-	A[2]
Wholesale	§ 2-2-3-16	-	-	-	-	-	-	-	-	C	L	A	A	-	-	-	A[2]

Durango's use table above provides a cross-reference to additional standards applicable to each land use (column in red).

Source: online.encodeplus.com/regs/durango-co/doc-viewer.aspx#secid-95

Similarly, **San Miguel County** adopted use-specific standards as part of its zoning code amendments prepared for the Wright's Mesa area in 2010. The standards reflect efforts in a rural community to control the size and scale of various uses such as logging, stables, and feedlots. Many standards focus on natural protection issues such as wildlife habitat and water quality protection.

Advantages and Key Talking Points

Developing use-specific standards to address potential hazard risks can be undertaken along with other zoning code amendments, and offer the following benefits:

- Accommodate safety and nuisance protection while allowing reasonable economic use of the property. A particular use might still be viable on a site, as long as it meets additional conditions.
- Can be tailored to a community's needs. Use-specific standards can apply to a land use in certain geographies, zoning districts, or based on adjacencies. They can also be drafted to require a higher level of scrutiny through the approval process.
- Use-specific standards encourage consistent treatment of similar uses across the board.
- Use-specific standards can accomplish multiple community goals. For example, standards can be drafted for industrial uses that protect surrounding neighborhoods

from noise and air pollution, while also preserving open space and natural hazard areas.

Challenges

As with any zoning code amendment, writing and passing new use-specific standards can be politically and administratively challenging. Developers may object to any new standards without a clear rationale. Other potential challenges include:

- Use-specific standards can result in the inability to develop a particular use on a landowner's parcel if it cannot meet defined standards for public safety and welfare.
- Use-specific standards can be perceived as inequitably targeting certain uses in a community.
- Developing use-specific standards requires substantial analysis (e.g., reviewing technical standards as they apply to industry standards and/or researching national best practices) to effectively accomplish the purpose without over-regulating.

Model Code Language and Commentary

Use-specific standards:

- **Proximity** – How close can the use be located to another property or another type of land use?
- **Compatibility** – What types of standards ensure that the use will be compatible with surrounding properties, districts, or land uses?
- **Safety** – What conditions are necessary to protect the public health, safety, and welfare of the community?
- **Environmental** – What standards help the community protect its valuable natural environment and resources?
- **Aesthetics** – What types of standards are necessary to protect the overall character of the community from an aesthetic point of view?

For hazard mitigation, most use-specific standards will relate to the categories of **proximity**, **safety**, and **environmental**. Those categories are discussed below, with additional detail on how to apply hazard mitigation principles through use-specific standards. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing

Commentary

Categories of Use-Specific Standards: *Many of the categories of use-specific standards overlap. For example, a use-specific standard aimed at distancing critical facilities from hazard areas ("proximity") could also be considered within the "safety" category.*

ordinances and programs from varying communities around the state, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Considerations for Use-Specific Standards: *When developing use-specific standards, use the local hazard mitigation plan (especially the risk assessment) to identify particular vulnerabilities to certain hazards. Then, review the table or list of land uses permitted within the community to determine which uses could potentially create, exacerbate, or be largely impacted by the potential hazards in the community. With that information, review current use-specific standards to determine if additional standards are necessary to reduce the overall risk to hazards.*

Proximity

The physical distance of a proposed new land use from existing land uses, particularly sensitive uses like schools, is an important consideration when local governments evaluate applications for new development. Proximity to sensitive uses and areas is an important general consideration when communities establish use-specific standards. For example, uses known for generating noise, dust, or odors should not be located close to residential neighborhoods.

The same is true for hazard mitigation. Consider appropriate distance requirements for particular land uses as they relate to hazards or known hazard areas. Examples include:

A. Fueling stations shall be located at least [*150 feet, or appropriate distance as determined by the local fire authority*] from any [*moderate or extreme wildfire risk area – or however defined on local maps*];
B. Hazardous material storage facilities shall be located at least 500 feet from any residential zoning district or residential use;
C. Heavy industrial uses shall be set back from all property lines a minimum distance of [*150-500 feet or more – may vary for residential and non-residential*];
D. Critical facilities, such as public safety facilities, emergency medical facilities, emergency shelters, public utility or distribution plants, communication facilities, and air transportation lifelines and corridors, shall be located at least [*150 feet, or appropriate distance as determined by the local fire authority, or local flood authority*] from any [*moderate or extreme wildfire risk area, or flood hazard area – or however defined on local maps*];

In addition, similar proximity standards can also apply to uses where large numbers of people visit at one time, or to densely populated residential development. These

uses may include religious institutions, hospitals, stadiums, hotels, community centers, and schools. For example, a community may want to prohibit a hotel or school from locating in an area with steep or unstable slopes whereas a single-family home could do so with proper mitigation.

Safety

The safety of individuals is an important consideration for land use regulations. For hazard mitigation, this means keeping people out of harm's way and paying particular attention to critical facilities and vulnerable or at-risk populations.

As an example, the Colorado Water Conservation Board (CWCB) Rule 6 for regulatory floodplains in Colorado requires uses under the following categories to be given special attention (location and/or elevation or floodproofing) through adopted floodplain regulations:

A. Critical facilities. Critical facilities can include many types of services and uses, including:

1. Public safety (police, fire, and emergency operation centers)
2. Emergency medical (hospitals, ambulance service)
3. Emergency shelters
4. Public utility plants or distribution
5. Communications (telephone, television, power, gas, internet, others)
6. Air transportation lifelines and corridors (airports, helipads)

Critical Facilities: *Critical facilities should be identified in the local hazard mitigation plan. If a local hazard mitigation plan does not exist, this section is a good starting point for consideration. The best practice is to locate critical facilities outside the floodplain and other high risk areas.*

B. Hazardous materials facilities. These types of uses can include:

1. Chemical plants
2. Laboratories using volatile materials
3. Refineries
4. Hazardous waste storage or disposal sites
5. Above ground storage of volatile materials

C. Vulnerable populations. Vulnerable or at-risk populations may include:

1. Elderly care facilities
2. Day care homes or facilities for youth or disadvantaged
3. Institutions of learning

D. Facilities vital to restoring normal services. This includes:

1. Essential governmental operations
2. Essential structures for colleges and universities

Under the CWCB rule, uses in one or more of these categories shall be protected using one of the following:

A. Location outside the regulatory floodplain; or
B. Elevation or floodproofing the structure per the standards outlined in the Rule.

This concept could be further expanded to other hazards and other facilities and could include other mitigation for safety purposes, such as:

A. Requiring a conditional use when located within a designated wildland-urban interface area;
B. Requiring a truck routing plan for heavy industrial uses;
C. Required submittal of a geotechnical report for areas within a mapped geologic hazard area; and/or
D. Emergency ingress and egress provisions.

Conditional Use: *Requiring a conditional use can ensure that the application will be subject to higher scrutiny among local government departments and other agencies such as the fire department.*

Environmental

Similar to protection of life and property, use-specific standards can be used to protect the natural environment. Vulnerable natural areas such as forested land, steep slopes, riparian corridors, and open grasslands can be susceptible to devastation during or following a disaster event. For example, landslides and wildfire can lead to sedimentation and/or flooding of nearby rivers; prolonged periods of drought can lead to increased risk of wildfire in forests and grasslands; and earthquakes can trigger landslides and subsidence of already unstable slopes.

Environmental Standards: *Application of environmental standards that are not necessarily associated with a particular use is typically covered elsewhere in the code through sensitive area protection standards. Use-specific standards are generally created when they apply only when certain land uses are involved and would not otherwise pose environmental impacts with other land uses. For example, temporary fireworks stands near forested areas are a potential concern, whereas temporary produce stands are not.*

Through use-specific standards, communities can limit the impacts of development on already vulnerable environmental conditions. Consider the following standards that protect environmental areas:

A. Transmission lines shall avoid the following areas:
   1. Slopes greater than 20 percent;
   2. Wetlands;
   3. Forests, unless running near the fringe of a forest and minimizing cutting;
   4. Soils susceptible to erosions that could create pollution or sedimentation issues;
   5. Areas with high-water tables; and
   6. Areas of unstable soils subject to significant slippage.

B. Heavy manufacturing or hazardous manufacturing shall be subject to appropriate conditions including safeguards and performance bonds to protect the health, safety, and welfare of the residents of the community and the natural environment.

C. Industrial wastes shall be disposed of in a manner consistent with federal and state law and the requirements of the Colorado Department of Public Health and Environment. Flammable and/or explosive materials shall be stored in compliance with national, state, and local fire codes with written recommendations from the [*appropriate local fire protection district*].

D. General or heavy industrial uses that include manufacturing or processing shall not be located within a [*water protection area, sensitive natural area – or other mapped water conservation area*].

Limitations on High-Water Uses: *Another consideration for limiting environmental impacts is to place limitations on high-water uses (such as golf courses and car washes) during periods of drought. Many communities already have standards in place for these types of uses, so local laws and conditions should be carefully reviewed.*

Key Facts

Administrative capacity	Experienced planner
Mapping	Technical mapping potentially required if use-specific standards are tied to specific geographic areas or specific mapped hazard areas
Regulatory requirements	Zoning ordinance

Maintenance	Minimal
Adoption required	Yes
Statutory reference	Municipalities (C.R.S. § 31-23-301) and counties (C.R.S. § 30-28-111) are explicitly authorized to regulate the location and use of buildings and structures for trade, industry, residence, recreation, public activities, or other purposes
Associated costs	Staff time

Examples

City of Durango Land Use and Development Code	online.encodeplus.com/regs/durango-co/doc-viewer.aspx#secid-95 Section 2-1-3-1, Interpretation of Use/Zone Matrices
Garfield County Land Use and Development Code	garfield-county.com/community-development/land-use-code.aspx Use-specific standards, Article 7, Sections 7-601 through 7-1201
City of Longmont Land Use Code	https://library.municode.com/co/longmont/codes/code_of_ordinances Standards for critical facilities, Section 20.20.080
San Miguel County Land Use Code	https://co-sanmiguelcounty-old.civicplus.com/DocumentCenter/View/221/Wrights-Mesa-Zone-Districts-New-Language-PDF?bidId= Wright's Mesa Code Amendments, Section 5-319 H

Landscaping Ordinance

Hazards Addressed

How it Works

Landscaping regulations establish minimum standards for the amount and types of landscaping, the location of landscaping, buffer and screening standards (to address visual impacts from development activities or site features), fence requirements, and installation and maintenance. Many codes also include standards for tree preservation, water efficiency and conservation, and low-impact development.

In addition to providing a more aesthetic environment, landscaping regulations can help reduce risk to natural hazards, including flood, drought, geologic hazards, wildfire, and extreme heat. Requiring a certain amount of landscaping reduces the amount of impervious coverage on a site, allowing water to percolate into the site instead of being conveyed across the site. Designating appropriate plant species for a dry climate can improve the water-efficiency of a site, which is especially important during periods of prolonged drought. Installing plants and ground cover helps stabilize steep and unstable slopes. Establishing standards for the type and location of landscaping can also reduce wildfire risk to structures.

Implementation

Landscaping regulations are typically adopted as part of the zoning and development regulations either as a standalone chapter or article, or as a component of the larger development standards article or chapter. Formal adoption by the local governing body is required to enact or modify the landscaping standards.

Landscaping regulations typically include the following fundamental elements, which are further described in the *model landscaping ordinance*.

The following items should be considered when developing a landscape ordinance:

- **Purpose and Intent.** The purpose and intent statement is the jurisdiction's opportunity to describe the reasoning behind, and benefits of, the landscaping ordinance, and its relationship to mitigating hazards.
- **Applicability.** The applicability section describes the types of development activities that are subject to the regulations, including thresholds for compliance for infill and redevelopment projects. This is important because one of the biggest challenges in planning for hazards is the ability to impact existing development.
- **Site Landscaping.** Site landscaping standards establish the essential landscaping rules for new development and redevelopment, such as how much landscaping is required, and where landscaping should be located. These standards are critical to mitigation efforts such as managing stormwater, preventing structure-to-structure ignitions during a wildfire, or reducing water use and creating resilience to drought events. Often these standards vary depending on the use type or zoning district (e.g., residential vs. commercial or industrial).
- **Parking Lot Landscaping.** Landscaping within parking areas is often separated from other site landscaping regulations because of the large amount of impervious surface involved. Even on sites with ample open space, it is still important to break up large areas of parking with plant material to help slow the flow of water across the site and to reduce the urban heat island effect. Another key consideration for many Colorado communities is establishing adequate areas for snow storage that are adjacent to paved areas. Such standards allow for infiltration of melting and runoff, and can ensure the protection of landscaped areas by requiring planting boxes, elevated planters, timbers, or other means.
- **Landscaping Materials.** The type of landscaping material used can be as important as the amount of landscaping called for. Plant species native to Colorado or the West, or otherwise drought-tolerant species, require less irrigated water, and can survive prolonged periods of drought. To address wildfire risk, local plant lists may differentiate appropriate species based on their flammability. In addition to specifying which plant species are allowed or recommended, communities may also want to identify species that are prohibited, for the reasons indicated above. Many communities also limit the amount of turf grass, or other high-water usage plants, by establishing maximum percentages.
- **Tree Preservation.** Protecting existing trees provides a way to reduce the urban heat island effect, reduce energy use, and allow water to infiltrate the ground instead of being conveyed away from the site. Communities vary in complexity of their tree-preservation standards. Some award credits for protecting existing trees, whereas more stringent standards require a minimum tree canopy to be maintained and identify specific species for tree replacement upon die off. Tree preservation standards can also be in direct conflict with wildfire risk reduction, since many communities require the removal or thinning of existing trees to maintain defensible space.

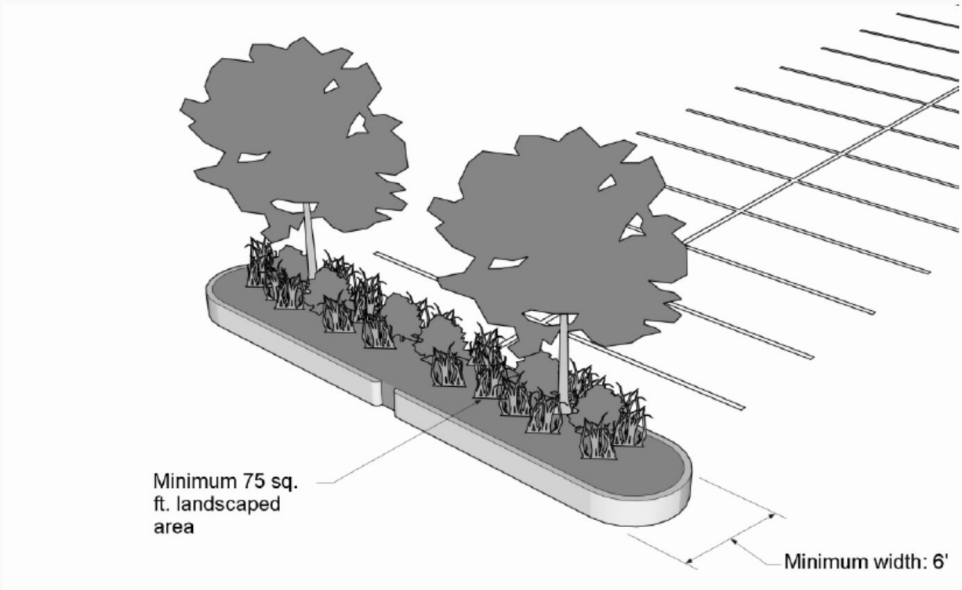
- **Landscaping Plan Evaluation.** Planners should consider hazard mitigation as part of a larger set of site development principles, and landscaping should be part of that evaluation to demonstrate how communities are protecting sensitive areas. The landscaping ordinance should establish a clear process for the review and approval of landscape plans associated with a site development application.
- **Installation and Maintenance.** Once a development is approved, and a building permit is issued, it is important to establish enforceable regulations for the installation of landscape materials. Landscaping can only be effective when it is properly maintained, so replacement standards for dead or dying vegetation are also often included. Irrigation systems are particularly important for water efficiency purposes, ensuring that minimal water resources are used, and that prolonged use of irrigation is not required for xeriscape landscaping areas.

When a development is proposed, the landscaping standards are typically evaluated as part of the overall development application. During the evaluation, the planner (or in some cases, a landscape architect or engineer) reviews the applicant's landscape plan for compliance with the various provisions in the landscaping regulations. This evaluation can also be conducted as part of a building permit review process if a site plan or specific development application is not associated with the proposed project. A site inspection – which often includes landscaping installation as part of the inspection – is typically conducted on a site prior to issuing a certificate of occupancy. Some communities also require financial security be posted to assure that landscaping is installed in a timely manner (within a year), and that the landscaping survives a certain number of growing seasons.

Where It's Been Done

Most communities regulate landscaping to some degree through their land use and development regulations; however, few have stated hazard mitigation as a major consideration behind such standards.

The **Town of Carbondale, Colorado**, recently adopted updated land use regulations in their Unified Development Code (UDC). Landscaping and screening standards were included as part of the development standards (Section 5.4; Chapter 17.05). Management of impervious coverage was an important consideration during the drafting of the UDC, and therefore the Town included several regulations to manage such impervious coverage. One of those features is the landscape island and rain garden requirement within parking areas. Not only does the Town require landscaped islands to break up large areas of parking, but they also require those areas to be designed to collect runoff and allow it to percolate into the ground through natural features in those islands. The figure below from Carbondale's UDC shows curb-cuts in the parking lot island to allow water to enter the island.



Source: Carbondale UDC, effective 2016

The **City of Indianapolis, Indiana**, recently adopted an updated consolidated zoning and subdivision ordinance that included new standards for landscaping. As with the Carbondale example, managing the City's impervious coverage was central to the update. To that end, Indy ReZone implements a unique incentive-based approach to encourage green infrastructure, called the *Green Factor*. Initially conceived by the City of Seattle, the *Green Factor* gives flexibility to developers to incorporate landscaping, buffering, and screening techniques that promote the integration of water quality, thoughtful design, and use of native plant materials.

Developers are required to fill out a worksheet documenting how their proposal achieves the minimum "green factor." Low-impact development options such as bioswales, rain gardens, and green roofs are worth more than traditional landscaping techniques, and previously undeveloped or underdeveloped sites must attain a higher Green Factor.

Green Factor worksheet for Indianapolis, IN.
Source: Indy ReZone, effective 2016

Summit County, Colorado, recently adopted a suite of amendments to its Land Use & Development Code to integrate wildfire hazard reduction with land use planning. Among the new and updated regulations are new defensible space requirements (Section 3604.P), flexible landscaping standards to accommodate defensible space provisions (Section 3603), requirements for non-combustible fencing within 10 feet of structures (Section 3505.17), and limitations on firewood storage within 30 feet of structures (Section 3815.02). These code amendments were the result of a larger effort to consider a holistic approach to wildfire risk reduction in the County through the Community Planning Assistance for Wildfire (CPAW) program.

Advantages and Key Talking Points

Benefits of implementing landscaping regulations include:

- Mitigating the amount of impervious coverage on a lot.
- Detaining and slowing the conveyance of water during flood conditions.
- Reducing the urban heat island effect.
- Protecting sensitive areas by ensuring adequate buffers are provided.
- Improving water efficiency by requiring native species and limiting the amount of turf grass.
- Providing defensible space from structures (wildfire mitigation).
- Stabilizing steep and unstable slopes.
- Reducing risk to existing development within hazardous areas.

Challenges

Challenges include the following:

- Landscaping regulations are adopted by ordinance, usually requiring a code amendment that can take time and resources (especially for smaller communities).
- Depending on the complexity of the regulations, administering the landscaping ordinance may require staff trained in landscape architecture.
- Landscaping regulations have to be coordinated with other site development features, and balanced with other political priorities. For example, requiring substantial landscape screening to lessen the visual impacts of new development is sometimes at odds with defensible space standards.

Key Facts

Administrative capacity	Planning staff with requisite training and certification; landscape architect on staff or under contract (depending on complexity of regulations)
Mapping	Not required
Regulatory requirements	Zoning and/or land development regulations

Maintenance	Minimal on the draft, but can make up a large percentage of the code enforcement complaints
Adoption required	Yes
Statutory reference	Counties C.R.S. § 30-28-111; § 31-23-301
Associated costs	Staff time for drafting and adoption process (may require outside landscape consultant depending on complexity of regulations)

Examples

City of Aurora Unified Development Code	https://www.auroragov.org/UserFiles/Servers/Server_1881137/File/Business%20Services/Zoning%20and%20Codes/Zoning%20Update/1%20Aurora%20UDO%20Final%20Draft%20REVISED%207-3-19.pdf
Town of Buena Vista Unified Development Code Section 4.4	http://buenavistaco.gov/DocumentCenter/View/2655/BV-UDC-Final
Town of Carbondale Unified Development Code Section 5.4	https://www.carbondalegov.org/document_center/Planning/Unified%20Development%20Code.pdf
Indy ReZone Green Factor Chapter 744, Article V	https://www.indy.gov/activity/zoning-and-subdivision-ordinance-indy-rezone
Sedona, AZ Land Development Code	http://www.sedonaaz.gov/your-government/departments/community-development/land-development-code
Summit County Land Use and Development Code	http://co.summit.co.us/255/Land-Use-Development-Code

For More Information

California Model Water Efficient Landscape Ordinance

https://planning.smcgov.org/water-efficient-landscape-ordinance-welo

Colorado State University: Native Plant Master

http://conativeplantmaster.colostate.edu/

Community Planning Assistance for Wildfire (CPAW)

https://planningforwildfire.org/

Home Landscaping for Fire
https://anrcatalog.ucanr.edu/pdf/8228.pdf

International Wildland-Urban Interface Code
https://codes.iccsafe.org/content/IWUIC2015

Urban Runoff: Low Impact Development
https://www.epa.gov/nps/urban-runoff-low-impact-development

Water Wise Landscaping Best Practices Manual (Sustainability Information)
https://www.colorado.gov/pacific/dola/publications-handouts

Model Code and Commentary

Commentary:

The landscaping ordinance contains the development standards for how much, what type, and the location and design of landscaping on a site. Although perhaps not the most intuitive connection to hazard mitigation, the landscaping ordinance presents several opportunities for reducing risk to flood, drought, geologic hazards, wildfire, and extreme heat. This model code and commentary describes how certain elements of a landscaping ordinance may reduce risk, and provides sample language for consideration.

The following sections provide example language for each of the common elements. Model language is in blue shading. Commentary is located in italics in the column at the right. The model language used in this document is based on existing ordinances from communities around the state and nation. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose and Intent

Purpose and Intent: *The purpose and intent statement is the jurisdiction's opportunity to describe the reasoning behind, and the benefits of, the landscaping ordinance. This section should elevate the importance of promoting landscaping approaches that are appropriate for hazard mitigation and drought adaptation during the site planning process.*

The purpose of this [*section/article/chapter*] is to ensure that landscaping is provided to:

1. Protect and enhance the visual appeal of the [*city/town/county*];
2. Contribute to high-quality development;
3. Conserve water resources by using sustainable design and maintenance techniques and plant species that are low water-use and regionally appropriate;
4. Improve water quality;
5. Reduce stormwater runoff in parking areas and other impervious areas;

6. Improve air quality;
7. Reduce the risk to wildfire; and
8. Buffer potentially incompatible neighboring land uses.

Applicability

The applicability section establishes what types of development and/or redevelopment are required to comply with the landscaping provisions.
For hazard mitigation, it is important to consider how the landscaping standards may apply to expansions, redevelopment, and infill.

New Development or Redevelopment

These landscaping standards shall apply to all new development and redevelopment, unless otherwise exempted in this Code.

Expansions or Enlargements

These landscaping standards shall apply to the following:

1. The gross floor area of an existing structure is expanded or enlarged by [*25 percent or more*]; or
2. The gross floor area of an existing structure is expanded or enlarged by [*15 percent or more*] within [*a mapped hazard area*]; or
3. There is a change of use of the existing building that requires an increase of off-street parking by [*25 percent or more*]; or
4. Any expansion or enlargement of a structure or land use that requires a [*conditional/special use permit*], as determined by the [*Director/Manager*].

Applicability: *Some communities establish thresholds for the types of expansions and redevelopment that may trigger compliance with landscaping standards. In doing so, communities can base those thresholds on type of use proposed, size (square footage), type of application, or location (zoning district or other mapped area). For hazard mitigation purposes, compliance with certain landscaping components can be tied to mapped hazard areas (like the WUI, high-hazard areas, or in areas with steep slopes).*

Addressing existing development: *One of the most difficult challenges in mitigating hazards is addressing existing development. The applicability section can establish what types of activities to existing development require compliance with the landscaping standards.*

Site Improvements

These landscaping standards shall apply when major parking area improvements are made including reconfiguring, reconstructing, or other similar projects. Resurfacing and re-striping projects are not considered major improvements.

Communities often adopt exemptions to identify areas or uses and activities that are not subject to the landscaping ordinance (or specified sections of the landscaping ordinance). One reason communities include exemptions to code standards is to avoid creating nonconformities (features that complied with the regulations when they were installed, but no longer comply after adoption of code updates). For example, if a new landscaping standard was adopted that limits turf grass for residential lots, any lots with more than the established limit would be deemed nonconforming. These policy issues can be challenging from a code enforcement standpoint. Another reason to exempt certain uses or activities is to encourage redevelopment and infill on otherwise challenging properties.

Exemptions

These landscaping standards shall not apply to the following areas or activities:

1. OPTION 1, (stricter approach): Individual single-family or two-family residential uses that are not part of a new subdivision, [*unless located in a mapped hazard area*];
2. OPTION 2, (less strict): Development of fewer than 10 single-family or two-family dwelling units, [*unless located in a mapped hazard area*].
3. Any nonresidential or mixed-use development of less than [*5,000 square feet*]; or
4. Any expansions or enlargements that do not meet the thresholds identified in Section [*x.x*] above.

Site Landscaping

Site landscaping standards describe what areas are required to be landscaped, and to what degree.

A common example of site landscaping standards is to require a minimum percentage of landscaped area on a site, which may vary by zoning district. The percentages can vary widely, with rural residential zoning districts requiring more landscaped area than urbanized nonresidential or mixed-use districts. It is important to consider the potential impacts that landscaped areas may have related to risk reduction and hazard mitigation. For example, although a higher percentage of landscaping may reduce impervious area (which is better

landscaping can also equate to additional fuels during a wildfire, or increased water requirements. These competing interests should be discussed when developing the landscaping ordinance.

Engineering and Technical Standards: *The zoning or development code should not always include detailed technical and engineering standards related to landscaping requirements. Most communities maintain separate standards manuals or technical specifications that contain detailed information related to site development (such as appropriate plant species, parking lot island curb design specifications, and when a soil amendment may be required). The benefit to leaving these outside of the zoning ordinance is that minor modifications to the detailed specs would not require an act of council/commission/trustees/etc.*

Minimum Percentage of Site Area to be Landscaped

Residential (Single-family and duplex)	**Residential** (Multifamily)	**Commercial and Mixed-use**	**Industrial**
30 percent	30 percent	20 percent	10 percent

Some communities do not establish minimum landscaping percentages at all, and rather rely on other standards to limit the amount of impervious area on a site. In such cases, a general provision for landscaped areas should be stated.

Required Landscaped Areas

Except for areas with native vegetation cover, any part of a site not used for buildings, parking, driveways, walkways, utilities, or other site improvements shall be landscaped with appropriate materials pursuant to Section [*x.x –cross-reference materials standards*].

Perimeter Landscape Buffers

Perimeter buffers can be required to ease transitions to adjacent land uses and to provide a uniform landscaping aesthetic within certain zoning districts or along key corridors. For hazard mitigation purposes, landscape buffers can be used to contain, divert, or convey water away from structures during a flooding event. Buffers can also be used as fuel breaks in heavily forested areas.

To ensure that hazard mitigation principles are possible within perimeter landscape buffers, communities should be flexible in terms of how much landscaping is required within the buffer, and allowing alternative designs when appropriate. General authority to approve alternative designs is provided later in this model in the landscaping evaluation procedures.

Perimeter landscape buffers, if required, should be coordinated with adopted stream buffer standards. Information on **stream buffers** can be found here: planningforhazards.com/stream-buffers-and-setbacks-model-and-commentary.)

Parking Lot Landscaping

Limiting the amount of parking required is possibly the most effective way to reduce impervious surface in parking areas; however, that reduction is achieved in the parking regulations and not in the landscaping ordinance. Parking lot landscaping is often addressed as a separate section within the landscaping ordinance. Communities vary in terms of the degree of design within parking areas. Variables include how much landscaping is required; whether or not landscaped islands are required; how stormwater is treated within a parking area; and whether or not additional perimeter landscaping is required.

Where should parking lot landscaping regulations be located? *Some communities locate parking lot landscaping regulations within the parking regulations in the zoning or development code, while others find it more intuitive to locate them in the landscaping regulations. There is no "best practice" other than to justify a logical decision based on preference and to appropriately cross-reference in both parking and landscaping sections.*

Thoughtful considerations for the types of landscaping (species/materials), and the amount of landscaping required in parking areas can help reduce the impacts during a flooding event and can help conserve water in times of drought. Additionally, any reduction in the amount of impervious area in a parking lot will reduce the heat island effect, especially during periods of extreme heat.

Some communities require certain stormwater management improvements in parking areas. For example, the Town of Carbondale requires landscaped islands or rain gardens as part of the parking area design standards. The model language below is based on that example.

Landscaped Islands and/or Rain Gardens Required

Landscaped islands and/or rain gardens shall be provided in parking areas along the ends of parking rows, adjacent to lot lines, and used to define the location and pattern of primary internal access drives.

A. Nonresidential and Mixed-Use Districts

In all nonresidential and mixed-use zoning districts, landscaped islands and/or rain gardens shall be used to separate rows of more than [*12*] parking spaces.

B. Residential Districts

In residential districts, landscaped islands and/or rain gardens shall be used to separate rows of more than [*six*] parking spaces.

Curb Design in Parking Areas

Internal landscape areas shall be curbed for protection of the landscape materials, but planted areas shall be installed at a lower grade than the parking lot pavement, and curbing shall allow drainage from the pavement to enter and percolate through the landscaped areas.

Stormwater Improvements within Parking Lots

Carbondale, CO: *The Town of Carbondale requires landscaped islands and/or rain gardens in parking lots. See their recently adopted Unified Development Code (UDC) here:* *carbondalegov.org/UDC%20with%20Appendix%20May%2017%202016.pdf*
Navigate to Section 5.4.3.C.

Duluth, MN: *The City of Duluth, Minnesota requires that curbing within parking areas allow drainage into landscaped areas.* *library.municode.com/mn/duluth/codes/legislative_code?nodeId=Chapter%2050%20-%20Article%20IV%20-%20Development%20Standards*
Navigate to Section 50-25.4

For many snow-prone mountain communities in Colorado, the issue of snow storage is important. An effective approach to addressing snow storage is to ensure adequate set-asides for snow storage adjacent to paved areas are provided, while also protecting landscaped areas. Some model language for snow storage standards most relevant to the landscaping ordinance is provided below, based on Summit County's standards:

Location

[*To the maximum extent practicable,*] snow storage areas shall be located in:

A. Sunny areas to help speed the snow melting process.

B. Revegetated areas to help with slowing the absorption of runoff, and prevent ponding.

Drainage

Drainage from snowmelt areas shall:

A. Divert snowmelt away from walks, driveways, parking areas, and other paved surfaces.

B. Divert snowmelt away from shaded areas to avoid freezing and ice hazards.

C. Protect waterways and adjacent properties by providing methods for filtering runoff before drainage leaves the site.

D. Minimize erosion.

Protection of Landscaping

Landscaping adjacent to snow storage areas that may be damaged or destroyed by snow storage activities shall be protected by the use of planters, elevated landscaping elements, timber walls, or other mechanisms approved by the [*Director/Engineer/City/County*].

Landscaping Materials and Water Conservation

This section addresses the types of planting materials allowed and the number of plant units required.

For hazard mitigation purposes, the type and amount of landscaping is important. For flooding, landscaping can determine how the site performs when flooded, and how much water can be conveyed and/or detained on site. For wildfire, some types of landscaping materials are more flammable than others, and the amount of vegetation equates to the amount of potential fuel. For drought and extreme heat, some species are more tolerant to periods of drought or extreme temperatures and require less water. Certain species may also be more prone to becoming projectiles during extreme wind or tornadoes.

Native species are the most suitable, and many communities maintain a list of appropriate native species. Native species can survive under normal climatic conditions and are therefore more water efficient. See the model language below, tailored from an example in Sedona, Arizona:

Sedona, Arizona: *Sedona's Land Development Code is currently being updated as part of a comprehensive rewrite project. Current drafts of the rewrite remove the specific requirements for evergreen species since those are discouraged by Firewise principles due to their burn properties. Learn more about the code update at: sedonaldcupdate.com*

A. A recommended list of native and adaptive plants suitable for landscaping in the area is listed in [*the administrative manual*]. Plants proposed to be used that are not on that list shall be demonstrated to have low water usage, and be drought tolerant and freeze resistant.

B. Selected plants shall meet the following minimum standards:

1. A minimum of 50 percent of plant species on a development site shall be native species as identified in [*the administrative manual*].
2. All required trees shall be a minimum of 8 feet high at planting; and
3. All required shrubs shall be a minimum of 2 feet high at planting.

Communities also vary in how they regulate the number of plants and/or trees. There can be differentiations based on use type (e.g., different for golf courses vs. single-family residential vs. shopping centers), different standards for private yards vs. treelawns, and exceptions allowed for urban environments.

Many landscaping ordinances also include standards for reducing the amount of high-water usage landscaping. Water-efficient landscaping materials help communities conserve water without sacrificing other objectives such as aesthetics and/or flood control. Some communities regulate the amount of native plants required – to avoid species that may require a lot of water. Other communities provide a list of specific water-efficient plants that are appropriate or refer to a regional- or state-approved plant species list.

Plant Materials

Plants shall be provided pursuant to the [*city/town/county*] approved [*plant list/planting guide*].

Plant Materials (more discretion)

Native, low-water, drought-tolerant, adaptive plants shall be used for all landscaping. Plants shall be suitable for the local soil conditions and climate.

External plant materials sources: *For communities that do not have a landscape architect on staff, and do not have an approved plant list, a reference in the development code can be provided to an external source of information for guidance on appropriate native species. The Colorado State University "Native Plant Master" is a good source of lists for Colorado-appropriate plant materials. Visit: conativeplantmaster.colostate.edu/*

Some communities place a maximum limit on the amount of turf grass used for new developments, and in more complex scenarios have separate watering rates depending on the amount of turf grass. Communities should consider the applicability of such limitations. For example, consider whether turf grass limitations will apply to single-family or duplex dwelling uses beyond those associated with a new subdivision.

Water Conservation

1. The water [*City/County/Town*] recognizes the importance of conservation and the protection of its water resources. The [*City/County/Town*] encourages the use of low-water planting materials and other landscaping techniques used to limit the amount of water use.
2. Xeriscape landscaping shall be incorporated into the overall landscaped area [*to the maximum extent practicable*]. Xeriscape landscaping shall require water irrigation for a period of three years to establish the landscaping. After three years no irrigation is required.
3. Turf grass limitation OPTION 1, (stricter approach): Grassed areas shall be planted with drought-resistant species pursuant to the [*adopted City/County/Town plant list*]. The [*Director*] may approve another variety or species for areas on the site that are heavily shaded.
4. Turf grass limitation OPTION 2, (less strict approach): [*To the maximum extent practicable*], the total amount of high-water use landscaping, pursuant to the [*City/County/Town*]'s specifications, shall not exceed [*50 percent*] of the required landscaped area and the total amount of high-water use turf grass shall not exceed more than [*30 percent*] of the required landscaped area.
5. The [*Director*] may approve greater areas of turf grass when it can be demonstrated that the proposed species and irrigation methods will not demand high water usage.
6. Plants or turf grass in a high water use zone shall not be planted on slopes or berms with a 4-to-1 (4:1) slope or steeper.

The "Green Factor": *The City of Indianapolis recently updated their zoning ordinance (2016) to implement several sustainable development features, including the "Green Factor." The Green Factor gives flexibility to developers to incorporate landscaping, buffering, and screening techniques that promote the integration of water quality, thoughtful design, and use of native plant materials. Developers are required to fill out a worksheet documenting how their proposal achieves the minimum green factor. Low-impact development options are worth more than traditional landscaping techniques, and previously undeveloped or underdeveloped sites must attain a higher Green Factor. For more information, visit: indy.gov/eGov/City/DMD/Current/Pages/ordinance.aspx Navigate to Chapter 744, Section 509.*

Low-Impact Development (LID) Standards

Low-impact development standards help reduce stormwater runoff and improve water quality through the use of natural on-site features (green infrastructure), in-lieu of conveying and/or storing water in piped infrastructure. These systems help reduce risk to natural hazards by improving permeability, and thus preventing conveyance during flood conditions (with an added benefit of improving water quality), help conserve water through the use of water-efficient plantings, and reduce the heat island effect by replacing hardscape with natural systems.

Communities can emphasize the importance of green infrastructure by providing descriptions of low-impact development (LID) options and including incentives, such as reduced parking requirements.

See the Stormwater Ordinance model code language for more.

Low-Impact Development: *Low-impact development (LID) standards mostly include green infrastructure solutions for managing stormwater runoff and improving water quality. The inclusion of such standards in landscaping ordinances is increasingly common; however, where the focus is on grading and drainage, the LID standards should be located with other grading and drainage standards in the zoning or development code.*

Improving Buildings and Infrastructure

Planning tools and strategies typically stop at the building line. This section addresses some of the tools (such as building codes) outside the typical planning realm that help communities reduce risk to hazards. Tools that improve a structure's chance of survival and protect valuable community infrastructure assets make a more resilient community. Building codes establish rules for building safely and provide engineering standards to ensure that structures located in hazard areas can withstand high winds, high waters, wildfire embers, and heavy snow load. They also protect critical infrastructure, which is the lifeline of a community during and after a major hazard event. Adopting the most current building code cycle gives a community an important boost in terms of hazard mitigation.

It is critical that land use planners work closely with building officials and emergency services personnel to coordinate the closely-related goals of planning-related regulations and building regulations. Planners can help raise and facilitate discussions of tradeoffs between competing community goals, such as historic preservation and infrastructure upgrades. Planners should strive to understand and become involved in building code issues in order to truly understand the importance of keeping the built environment resilient over time. Once buildings are erected, they may remain for many years. It is imperative that planners help

Manufactured Housing – Location, Location, Location!

Today's manufactured homes are dramatically different in appearance from the "mobile homes" of yesteryear, with estimates that more than 90 percent of today's manufactured homes never move from their original site. Manufactured homes are now available in a variety of designs, floor plans, and amenities. In terms of hazard risk, the concern with manufactured homes is not their construction quality, but rather their location. If a manufactured home is located in the floodplain, it is at risk of being damaged by an event like the Front Range storm in 2013.

*In the **City of Evans**, 203 manufactured homes were destroyed when the South Platte River flooded in 2013. The major flooding issues resulted from the location of the homes within the floodplain. Each of the manufactured homes destroyed were constructed to the HUD 3280 Construction Standard. Following the 2013 floods, the City revised its municipal code to address development in the floodplain. Under the new code, construction in special flood hazard areas requires both manufactured housing and stick-built housing to be elevated to 36 inches above base flood elevation.*

Citations:

David Burns, Emergency Management Coordinator, City of Evans, Colorado, Personal Communication, August 2015.

References:

Manufactured Housing Institute
manufacturedhousing.org/default.asp

Colorado Department of Local Affairs, Division of Housing
Rick Hanger, Housing Technology and Standards Manager
housing.helpdesk@state.co.us

Evans Municipal Code, Chapter 16.04.200 Specific standards for construction in special flood hazard areas:
http://www.cml.org/uploadedFiles/CML_Site_Map/_Global/pdf_files/FloodAreaDev_Ordinance_Evans.pdf

Additional Example: Longmont Municipal Code, Chapter 20.20 Provisions for Flood Hazard Reduction:
municode.com/library/co/longmont/codes/code_of_ordinances?nodeId=PTIICOOR_TIT20FLRE

educate local officials and citizens on how solid construction methodologies can help protect the community and local infrastructure from hazards.

This section explores tools that communities can use to improve design and construction of structures and other important infrastructure in a community. Tools profiled in this section include:

- Building Code
- Critical Infrastructure Protection
- Wildland-Urban Interface Code
- Capital Improvement Plan

Residential and Community Safe Rooms

In 2014, the Natural Hazard Mitigation Association prepared the study "Hide from the Wind: Tornado Safe Rooms in Central Oklahoma" for the Federal Emergency Management Agency (FEMA), which analyzed tornado safe rooms in central Oklahoma—an area of the U.S. that has experienced the nation's highest frequency of violent tornadoes. The study sought to determine the prevalence of safe rooms (by definition, a room or space that is specially anchored and armored to provide near absolute protection during a tornado or wind storm) and provide lessons learned that can be applied to other communities at risk from these natural hazards.

One of the success stories in the study highlights Moore, Oklahoma. As of May 2014, Moore reported 5,500 registered storm shelters for its city's 23,000 residential properties; the city estimates that as many as 80 percent have been self-funded and the number of safe room installations continues to climb. A variety of financial incentives and unified messages delivered through multiple trusted sources contributed to the successful implementation of this mitigation strategy. The study also found that most people invest in safe rooms to not only protect their families but also to improve their property values. The full study includes many other case study examples and is available at: nhma.info/publications/nhma-safe-room-report.

Additional Safe Room resources from FEMA are available at fema.gov/safe-rooms and include the following:

Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business, FEMA P-320, Third Edition / August 2008. This publication provides safe room designs that show a builder/contractor how to construct a safe room for a home or small business, and includes design options for safe rooms located in the basement, in the garage, or in an interior room of a new home or small business. (fema.gov/fema-p-320-taking-shelter-storm-building-safe-room-your-home-or-small-business

Building Code

Source: Clarion Associates

Hazards Addressed

How it Works

The regulation of building and structure design, construction, compliance, and occupancy has existed since the early 1900s, intended to protect the public health, safety, and general welfare. From the early 20th Century until 1994, three separate non-profit organizations (Building Officials and Code Administrators International, Inc. (BOCA); International Conference of Building Officials (ICBO); and Southern Building Code Congress International, Inc. (SBCCI)) developed model codes used by the building community.

Although these separate organizations were effective and responsive to the nation's needs, they recognized the value of having a single set of codes. They responded by creating the International Code Council (ICC), a group that develops and makes available a comprehensive and coordinated set of International Codes, including:

- International Building Code (IBC)
- International Energy Conservation Code (IECC)
- International Existing Building Code (IEBC)
- International Fire Code (IFC)
- International Fuel Gas Code (IFGC)
- International Green Construction Code (IGCC)
- International Mechanical Code (IMC)
- ICC Performance Code (ICC PC)

- International Plumbing Code (IPC)
- International Private Sewage Disposal Code (IPSDC)
- International Property Maintenance Code (IPMC)
- International Residential Code (IRC)
- International Swimming Pool and Spa Code (ISPSC)
- International Wildland Urban Interface Code (IWUIC or WUI)
- International Zoning Code (IZC)

The International Codes provide safeguards and ensure uniformity in the construction industry. One or more of these International Codes becomes the law of a particular state or jurisdiction when formally adopted (and often amended) by the appropriate state or local governmental authority.

Statewide building codes—and adequate enforcement of codes—play a vital role in public safety and loss prevention. They can reduce the need for public disaster aid and increase a community's resilience. While the state does not have a mandatory code, most local governments in Colorado have adopted all or most of the International Codes listed above. If a county or municipality does not have a building code, factory-built structures and buildings constructed on site intended for multiple occupancy are subject to building standards set forth by the state Division of Housing. According to the *Natural Hazard Mitigation Saves: 2017 Interim Report*, released by the National Institute of Building Sciences, implementing mitigation measures in new construction to exceed select provisions in the 2015 IBC and the 2015 IRC and the implementation of the WUI Code saves society an average of $4 for every $1 spent on mitigation.

If a county has enacted a building code, it is also required to adopt and enforce a building energy code that meets or exceeds the standards in the 2003 International Energy Conservation Code (IECC). The relatively new International Green Construction Code (IGCC) was released by the ICC in 2010 and was created to aid in the construction of sustainable buildings in the business and residential sectors.

In addition to the IGCC, there are other International Codes designed to address specific hazards such as the Wildland-Urban Interface Code (IWUIC or WUI Code). See separate tool profile on the WUI Code.

Implementation

Formal adoption by the local governing body is required to enact or modify a building code. Revised versions of the International Codes are released by the ICC on a three-year cycle, allowing states and jurisdictions the opportunity to adopt the most up-to-date standards. It is common for state and local jurisdictions to adopt revised codes every other cycle so they can

maintain a uniform set of standards for longer than a three-year period. This also provides a level of predictability to those using and administering the codes.

To administer the code, most local governments employ a code official (building official) and/or a department overseen by the building official who conducts inspections to ensure structures are constructed in compliance with the local building code. Sometimes small or rural jurisdictions contract with the county or a private firm to provide building inspection services. In many communities there is a person on the building department staff who is familiar with local hazards and how they are mitigated through local code provisions and other ordinances (for example, a certified floodplain manager).

Where It's Been Done

Boulder County has a long history of utilizing building code regulations to address wildfire hazard in their wildland-urban interface. Building code regulations were first implemented in the late 1980s when two local fires (including the Black Tiger fire that destroyed 46 structures) prompted increased awareness of wildfires and home loss, and have continued to evolve since then. Original regulations focused on roof requirements but have expanded through a series of local amendments to include defensible space (vegetation management) and ignition-resistant materials and construction. Currently, any development that goes through the planning process is required to have a wildfire mitigation plan. Prior to the building permit being issued, the plan needs to be reviewed and approved. While this regulatory approach covers new construction (including new homes, additions, and remodels), Boulder County complements this regulatory process with its Wildfire Partners program—a voluntary approach that enables existing homeowners to request an on-site property assessment and receive mitigation guidance about their home and landscape. Together, the regulatory and voluntary/educational approaches are reaching out to help both new and current residents mitigate their property against wildfire risk (*Planning Building & Zoning*, 2016).

Larimer County adopted its first building code in 1972, and today continues to adopt the most current editions of the International Building Code with local amendments. A recent amendment to the code requires wildfire hazard mitigation standards for new construction. This section establishes minimum standards for the design and construction of new or substantially improved buildings in wildfire hazard areas for the protection of life and property. Requirements include specifications for fire-resistant construction practices in addition to the

Development in Fort Collins, Larimer County, CO.

Source: Marek Uliasz

provision and maintenance of defensible space in compliance with the guidelines prescribed by the Colorado State Forest Service. They also address standards for liquid propane gas facilities, containers, and tanks and requirements for the installation of spark arrestors for chimneys. These amendments apply to all locations within the wildfire hazard area as defined in the Larimer County Wildfire Mitigation Area Map. They are enforced by the Building Official who has the authority to approve alternate materials and methods of compliance not specifically prescribed by the code so long as they are equivalent in terms of suitability, effectiveness, fire resistance, durability, and safety. These code amendments are a critical component to the County's broader Wildfire Safety Program (*Building*, n.d.a).

Boulder, Larimer, and Weld Counties (Flood Mitigation). While most communities in Colorado have adopted building codes based on international standards that include minimum flood-resistant design standards, the State of Colorado requires each to adopt an amendment to these provisions in compliance with its own "Rules and Regulations For Regulatory Floodplains In Colorado" (2011) as established by the Colorado Water Conservation Board (CWCB). These rules include higher regulatory standards that exceed most codes and minimum standards of the National Flood Insurance Program (NFIP), and communities have the option to adopt even higher standards through their own local ordinances and building code amendment process.

One common approach to higher regulatory standards is the adoption of **freeboard**: an additional margin of safety expressed in feet above a predicted water surface elevation, typically defined as the Base Flood Elevation (BFE) on a FEMA Flood Insurance Rate Map (FIRM). In 2011, CWCB amended its rules to require one foot of freeboard for all new or substantially changed structures in floodplains. A number of communities in Colorado had already amended their local building codes and relevant ordinances to meet or exceed this standard, and the risk reduction benefits of doing so were realized following the September 2013 floods. For example most communities in the hard hit counties of Boulder, Larimer, and Weld had amended their codes to include a freeboard requirement – and many include a two foot freeboard. A 2015 FEMA study determined that $183 million in losses were avoided in these three counties during the 2013 flood event through these more stringent regulatory practices (*Reducing Losses*, 2015).

Advantages and Key Talking Points

Benefits of implementing a building code include:

- Protecting the public health and safety and the safety, protection, and sanitation of new structures.
- Protecting financial investments and property values. If construction does not comply with current recommended codes the structure may be at greater risk for damage and loss.
- Property insurers may not cover work done without permits and inspections.
- Ensuring that structures have the physical integrity to endure hazard conditions.

Challenges

The biggest challenge for a community considering adoption of a building code for the first time (or adding additional requirements to address hazards like wildfire) is gaining public support—especially for communities with a lower risk to hazards or a short history of hazard events. Another challenge includes proper administration and enforcement of the building code, which requires someone with training, preferably ICC certification.

Key Facts

Administrative capacity	Building officials with requisite training and certification
Mapping	Not required
Regulatory requirements	Local Building Code
Maintenance	Yes
Adoption required	Yes
Statutory reference	Counties C.R.S. § 30-28-201; Municipalities C.R.S. § 31-15-601
Associated costs	Staff time, generally offset by building permit fees. Cost of training workshops sponsored by the Colorado Chapter of ICC

Examples

Boulder County Building Department	https://www.bouldercounty.org/property-and-land/land-use/building/building-safety-inspection-services/
Larimer County Building Department	larimer.org/building
Colorado Energy Code	colorado.gov/pacific/dola/colorado-energy-codes-0

For More Information

International Construction Code

iccsafe.org

Colorado Chapter of the International Code Council

coloradochaptericc.org

International Fire Code

https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/ifc/

International Green Construction Code

https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/igcc/

Insurance Institute for Business and Home Safety
disastersafety.org

Federal Alliance for Safe Homes (FLASH)
flash.org

International Wildland-Urban Interface Code
https://shop.iccsafe.org/media/wysiwyg/material/3850X12-toc.pdf

ICC 600-2014: Standard for Residential Construction in High-Wind Regions
https://codes.iccsafe.org/content/ICC6002014?site_type=public

National Fire Protection Association
Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1141

Model Code and Commentary

Commentary

The International Code is developed by the International Code Council (ICC) establish standard building safety and engineering regulations and help protect critical infrastructure, which is the lifeline of a community during and after a major hazard event. Jurisdictions have the option of adopting local amendments to the International Codes that are tailored to address risks associated with hazard areas. While it is not required, adopting more stringent standards to mitigate hazards leads to safer, stronger, and more resilient communities.

The types and associated levels of risk can vary widely among communities. Amendments to the local building code depend largely on area-specific conditions and/or mitigation objectives that the community has defined relative to one or more hazards. This model has been prepared from a planner's perspective and presents several examples where tailored building code standards, specifically related to hazard mitigation, can be implemented into local building codes. Local building officials and other hazard mitigation staff are the administrators of building codes and should take the lead role in tailoring language for your jurisdiction and selecting appropriate methodologies.

Land development and zoning codes address mostly site conditions and exterior building treatment, but rarely address what happens within the building itself before, during, or following construction. Building code standards are most effective when paired with other hazard mitigation strategies that are identified in this guide, specifically: Community Wildfire Protection Plan; Hazard Mitigation Plan; Resilience

Planning; Conservation Easement; Stream Buffers and Setbacks; Stormwater Ordinance; Site-Specific Hazard Assessment; Subdivision and Site Design Standards; and Wildland-Urban Interface Code.

Text in blue shading provides model language while commentary is located in *italics* in the column at the right. The model language used in this document is based on existing building codes from communities around the state and nation. The language is illustrative only; consult local building officials and legal counsel to tailor language for your jurisdiction.

Organization of this Model

Following some introductory material on applicability and submittal requirements, the remainder of this model is organized by hazard. Some hazards include more building-code related information than others, whereas others are either not included at all or are better addressed through site development standards.

Cost-Benefit Considerations

In 2017, the National Institute of Building Sciences released an Interim Report, *Natural Hazard Mitigation Saves*, that is intended to inform future code changes to make communities more resilient, help jurisdictions make decisions on what codes to adopt and enforce, and assist policymakers in developing effective federal programs that support pre-disaster mitigation. The report also includes research that helps quantify the benefits of exceeding the baseline standards found in the 2015 International Building Code (IBC) and 2015 International Residential Code (IRC). The report suggests that implementing measures in new construction to exceed select provisions in the 2015 IRC and 2015 IBC and implementation of the IWUIC saves society approximately $4 for every $1 spent on mitigation. The benefit-cost ratio increased further to $6 for every $1 spent on mitigation provided by federal mitigation grants through the Federal Emergency Management Association (FEMA), the U.S. Economic Development Administration (EDA), and the U.S. Department of Housing and Urban Development (HUD).

New Construction Versus Existing Structures

Applying standards to new construction is a conventional approach to ensuring life safety is protected. However, retrofitting existing structures to today's modern standards is less straightforward. Older structures can be at a higher risk of sustaining damage during a natural hazard event if they are not upgraded through renovation and repair projects over time. The

Code-Specific Applicability Standards: *Separate applicability statements and exceptions can be adopted specific to each building code category that is adopted by the community (i.e., residential, gas, mechanical, plumbing, property maintenance, fire prevention, energy, existing building, electrical, green construction, performance, etc.). This provides the community with the flexibility to exempt specific building code requirements for specific projects or improvements for both new and existing structures.*

For example, loafing sheds and similar detached accessory structures within the wildfire hazard area of Larimer County are not required to meet the wildfire hazard mitigation requirements.

International Existing Building Code (IEBC) establishes standards for when existing buildings are required to be made compliant with seismic design provisions, flood design requirements, and other International Codes as a result of alterations, repairs, additions, changes of occupancy, and relocations (IEBC 2015 Chapter 1, Section 101; Chapter 3, Section 301; and Chapter 4).

Applicability Thresholds

To ensure that a community's building stock (both old and new) is resilient, local governments should identify thresholds for when new and existing projects are required to comply with the adopted building code standards. Such thresholds are often included in the applicability section of the building code.

Note: This language can be added to Section 104 of Chapter 1 of the IBC:

Duties and Powers of Building Official

For applications for reconstruction, rehabilitation, repair, alteration, addition or other improvement of existing buildings or structures located in [*insert jurisdiction name here*] and [*insert hazard area here*], the building official shall determine if the proposed work constitutes substantial improvement or repair of substantial damage.

Where the building official determines that the proposed work constitutes substantial improvement or repair of substantial damage, and where required by this code, the building official shall require the building to meet the requirements of IBC Section 1612, Flood Loads; IRC Section R322, Flood Resistant Construction; and [*insert code reference here*], as applicable.

Duties and Powers of Building Official: *Chapter 16, of the International Building Code includes general structural design standards as well as specific standards for snow loads, wind loads, soil lateral loads, rain loads, flood loads, and earthquake loads. If the building official determines that substantial improvement or repair is being conducted, the IEBC requires compliance with only the flood loads in Section 1612. Communities could elect to require compliance with more structural design standards found in Chapter 1612, or other standards of the International Codes.*

Application Submittal Requirements

It is critical that staff reviewing a building permit request is provided with the necessary information to help them identify the level of risk associated with that project. Depending on the nature of the request, it is common for communities to require that all building permit applications (depending on the request) be accompanied

by a site plan. In cases where improvements are proposed in highly sensitive areas, a Site-Specific Hazard Assessment may be required by the building official. The jurisdiction's building code can establish what type of information is required to be on the site plan.
Note: This language can be added to Section 107 in Chapter 1 of the IBC:

Site Plan

The construction documents submitted with the application for permit shall be accompanied by a site plan drawn in accordance with an accurate boundary line survey showing to scale the:

1. Topographic contours
2. Flood hazard areas;
3. Floodways;
4. Design flood elevations;
5. Fire hazard areas;
6. Existing vegetation;
7. Rock formations;
8. Fault lines; and
9. [*Any other hazard specific features identified or required by the building official*].

The building official is authorized to waive or modify the requirement for a site plan where the application for permit is for alteration or repair or where otherwise warranted.

Submittal Requirements: *The submittal requirements for each community should be tailored to address the specific hazard concerns in the area. The application materials should include all of the pertinent information needed by staff to determine if the proposed project complies, or does not comply, with all of the jurisdiction's adopted codes and amendments.*

More sophisticated standards may require applicants to provide additional information. Each community should consider their level of staff resources and training when crafting standards; some may consider hiring a third party to review specialized or technical plans associated with natural hazards.

Floods

The best way to mitigate risks associated with flooding is to avoid constructing in areas that are at risk for flooding. The Stream Buffers and Setbacks section and Stormwater Ordinance section of this guide provides guidance for preventing development near flood risk areas and management of on-site stormwater.
Many communities have adopted floodplain regulations as part of their land development codes that are separate from the community's building codes. Colorado has minimum requirements for floodplain regulations that are established by the Colorado Water Conservation Board. Some Colorado standards for certain floodplain management activities exceed those required by the

National Flood Insurance Program (NFIP). In those cases, the stricter of the State standards take precedence. Addressing existing structures located in flood-prone areas is particularly challenging. Existing structures can use flood mitigation techniques (aside from avoidance of floodplain areas) including:

- Dry flood-proofing (making the building watertight to prevent water entry);
- Wet flood-proofing (making uninhabited or non-critical parts of the building resistant to water damage);
- Relocation of the building; and
- Incorporating floodwalls into site design to keep water away from the building.

In addition to the techniques above, a relatively simple approach to preventing water damage to structures is requiring gutters and downspouts on all buildings to direct water away from the foundation to prevent damage from trapped moisture. For this reason, Boulder County has adopted amendments to the IBC requiring all buildings (with exception to a few) to provide gutters or downspouts.

Note: This language can be added as a new Section 1805 in Chapter 18 of the IBC:

Dampproofing and Waterproofing

Gutters, downspouts, and downspout extensions are required on all buildings.

Exceptions:

1. Post framed buildings.
2. Buildings where, in the opinion of the building official, the gutters will become damaged by sliding snow.
3. Roofs with eaves or overhangs of six feet or greater.
4. Roofs that are constructed with internal roof drains.
5. Buildings where an approved alternate means of drainage is designed by a soils engineer or other qualified registered design professional.

Flood Mitigation Examples: *The following jurisdictions have adopted standards related to flood mitigation in their respective land development codes:*

Weld County: Chapter 29, Article II, Sec. 29-2-120

Sliding Snow and Damage to Gutters and Downspouts: *Sliding snow and ice accumulations on rooftops can cause serious damage to gutters and other roof components. Projects at risk of damage from sliding snow and ice should consider alternative gutter and downspout designs to ensure proper drainage and functionality during all seasons. Adjusting architectural design and gutter position so that sliding snow and ice will not impact the gutter systems is one way to prevent such damage. Additionally, a wide variety of "snow guards" are available that can eliminate sliding snow problems and thus ensure proper drainage and localized flood prevention.*

Larimer County: Land Use Code 4.2.2

Boulder County: Land Use Code Article 4, 4-400

Another strategy for minimizing the risk of flood through building design is by installing a vegetated roof or green roof. A green roof refers to roof surfaces that have been designed to incorporate large areas of vegetation. Green roofs provide several benefits to the community including improved aesthetics, reduced heat island effect, and retaining and reducing peak stormwater runoff during rain events. While it is common for communities to incentivize the construction of green roofs, some cities including Denver, Toronto, Washington D.C., and San Francisco, require their construction.

Drought

Drought originates from a lack of precipitation over an extended period of time, resulting in a water shortage. The demand that people place on a water supply can exacerbate the impacts of drought. Local government can establish policies and implement strategies to manage and protect water resources so that impacts are minimized during times of drought. Some communities have adopted amendments to the International Plumbing Code (IPC) and the IRC to reduce flow rates through water fixtures to conserve limited water resources. In addition to adopting local building code amendments, upgrading water supply and delivery systems to eliminate breaks and leaks will help conserve water. The model code language below provides additional guidance on how drought impacts can be minimized.

Note: This language, which was taken from the City of Westminster Building Code, can replace the figures in Table P2903.2 found in Section P2903 in Chapter 29 of the IRC:

Colorado Legislation: *In 2016, the Colorado Legislature passed a law (Colo. Rev. Stat. § 6-7.5-102) banning the sale of new plumbing fixtures that have not been certified by the EPA's WaterSense Program or successor program.*

Maximum Flow Rates and Consumption for Plumbing Fixtures and Fixture Fittings

Lavatory faucet: 1.5 gpm at 60psi

Shower head: 2.0 gpm at 60 psi

Sink faucet: 2.2 gpm at 60 psi

Water closet: 1.28 gallons per flushing cycle

Note: This language, which was taken from the City of Westminster Building Code, can be added to Section 601 in Chapter 6 of the IPC:

Water Conservation

1. Water recycling systems shall be mandatory for all automatic full- service commercial car wash facilities constructed after [*insert effective date here*].
2. Water recycling systems shall not be mandatory for manual self-service commercial car wash facilities.

Note: This language, which was taken from the City of Denver Building Code, can be added to Section 401 in Chapter 4 of the IPC:

Rain Sensing

An approved rain sensing system shall be installed on all new automatic lawn sprinkler systems. Said rain sensing system shall be capable of turning the lawn sprinkler system off in the event adequate rain has fallen.

Note: This language, which was taken from the City of Westminster Building Code, can replace the figures in Table 604.4 found in Section 604 in Chapter 6 of the IPC:

Lavatory, private: 1.5 gpm at 60 psi

Lavatory, public (metering): 0.25 gallons per metering cycle

Lavatory, public (other than metering): 0.5 gpm at 60 psi

Shower head: 2.0 gpm at 60 psi

Sink faucet: 2.2 gpm at 60 psi

Urinal: 0.5 gallons per flushing cycle

Water closet: 1.28 gallons per flushing cycle

Wildfire

As residential developments expand into wildland areas, people and property are increasingly at risk from wildland fire. Several preventative measures can be

taken to minimize the spread of fire on the site as well as to make the building more fire-resistant. In addition to adopting local building code amendments to protect structures, the Wildland-Urban Interface Code and the Community Wildfire Protection Plan sections of this guide provide guidance for how wildfire hazards can be minimized through other measures.

Note: This language, which was taken from the Boulder County Building Code, can be added to Section 723 in Chapter 7 of the IBC:

Generally

Unless more restrictive requirements apply, the ignition-resistant construction and defensible space requirements of Section [R327] of the amendments to the IRC shall be applicable to all new buildings, additions, and repairs.

Note: This language, which was taken from the Larimer County Building Code and the Boulder County Building Code, can be added as a new Section 327 in Chapter 3 of the IRC:

Defensible Space

1. Defensible space in compliance with current Colorado State Forest Service guidelines shall be required on all new construction in the [*hazard area*].
2. Any landscaping materials or natural ground cover within three feet of the exterior walls of the building shall be a non-combustible surface – no landscaping– over a weed barrier within five feet of exterior walls. The noncombustible surface should extend underneath and two feet past the dripline of decks.
3. For additions equal to or greater than [*insert percentage of the total square footage of the original structure here*], the defensible space shall be provided around the entire structure.

Evaluation of the defensible space will be based upon:

1. Current Colorado State Forest Service standards and guidelines; and

Wildfire Building Code Amendment Examples: *To review all of the amendments to the Boulder County and Larimer County building code, please use the following links:*

Boulder County:
Boulder County Building Code Amendments

Larimer County:
Larimer County Building Code Amendments

Improvements that Trigger Defensible Space Requirement: *Larimer County requires that any additions that are equal to or greater than 50 percent of the original square footage of the structure trigger the need to comply with the defensible space requirements. This percentage should be tailored to each community and may align with thresholds for nonconforming structures to comply with other site features.*

2. Site specific vegetation and topographical characteristics

The Building Official may allow alternatives to the Colorado State Forest Service standards and guidelines based on specific site conditions.

1. Defensible space areas created as required by this code or other referenced documents within the [*community hazard mitigation plan*] are to be maintained by the property owner.
2. No re-planting or new planting of trees, shrubs, or other vegetation that would violate the defensible space requirements of this section shall be permitted.

Exterior Walls

1. Exterior walls of buildings or structures shall be constructed with one of the following methods extending from the top of the foundation to the underside of the roof sheathing:
    a. Noncombustible materials approved for a minimum of one-hour fire-resistance-rated construction on the exterior side.
    b. Approved noncombustible materials.
    c. Heavy timber or log wall construction.
    d. Fire-retardant-treated wood labeled for exterior use on the exterior side.
    e. Ignition-resistant materials on the exterior side.

Exterior Windows and Glazing

1. Exterior windows, window walls, glazed doors, windows within exterior doors, and skylights shall be tempered glass, multi-layered glazing, glass block, or have a fire protection rating of not less than 20 minutes.
2. Unless they are part of a fire-rated assembly, window frames and sashes may be constructed using any material permitted by this code. Windows with unreinforced vinyl frames or sashes are not permitted.

Exterior Doors

1. Exterior doors and garage doors shall be approved noncombustible construction, metal clad, solid core wood not less than 1 3/4 inches in thickness, or have a fire protection rating of not less than 20 minutes.
2. Windows within doors and glazed doors shall comply with exterior window and glazing standards.

Vents

1. Attic ventilation openings, foundation or under-floor vents, or other ventilation openings in vertical exterior walls and vents through roofs shall not exceed 144 square inches each.
2. Such vents shall be covered with noncombustible corrosion-resistant mesh with openings not to exceed 1/8 inches or shall be designed and approved to prevent flame or ember penetration into the structure.
3. Gable end and dormer vents shall be located at least 15 feet from property lines and shall be designed and approved to prevent flame or ember penetration into the structure.
4. Under-floor ventilation openings shall be located as close to grade as practical.

Roof Covering

Roof covering materials shall be listed Class A roof covering materials or be constructed as a Class A roof

assembly. For roof coverings where the profile allows a space between the roof covering and roof decking, the space at the eave ends shall be fire stopped to preclude entry of flames or embers, or have one layer of 72-pound (32.4 kg) mineral-surfaced, non-perforated cap sheet complying with ASTM D 3909 installed over the combustible decking.

Roof Valleys

When provided, valley flashings shall be not less than 0.019 inch (No. 26 galvanized sheet gage) corrosion-resistant metal installed over a minimum 36-inch-wide underlayment consisting of one layer of 72-pound mineral-surfaced, non-perforated cap sheet complying with ASTM D 3909 running the full length of the valley.

Protection of Eaves

1. The leading edge of the roof at the fascia shall be finished with a metal drip edge so that no wood sheathing is exposed.
2. Eaves, fascias, soffits, covered decks, and covered porch ceilings shall be protected on the enclosed underside by any one of the following materials or methods:
    1. Noncombustible materials;
    2. Ignition-resistant materials;
    3. Materials approved for a minimum of 1-hour fire-resistance-rated construction;
    4. 2-inch-thick nominal dimension lumber;
    5. 1-inch-thick nominal fire-retardant-treated wood;
    6. 3/4-inch-thick nominal fire retardant-treated plywood labeled for exterior use; or
    7. Any materials permitted by this code.

Gutters and Downspouts

1. Gutters, downspouts, and gutter covering devices shall be constructed of noncombustible material.
2. Gutters shall be provided with an approved means to prevent the accumulation of leaves, pine needles and debris in the gutter.

Liquid Propane Gas

Liquid propane gas containers and tanks installed in the [*hazard area*] shall be located within the defensible space in accordance with the International Fire Code.

Spark Arrestors

Chimneys serving fireplaces, woodstoves, barbecues, incinerators, or decorative heating appliances in which solid fuel or liquid fuel is used, shall be provided with a spark arrestor.

1. Spark arrestors shall be constructed of woven or welded wire screening of 12 USA standard gage wire (0.1046 inch) (2.66 mm) having openings not exceeding one-half inch.
2. The net free area of the spark arrestor shall not be less than four times the net free area of the outlet of the chimney.

Definitions

Defensible Space: An area either natural or manmade, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of an advancing wildfire and to create an area for fire suppression operations to occur.

Fire-Retardant-Treated Wood: Wood meeting the requirements of Section R802.1.5 of the IRC or Section 2303.2 of the IBC.

Heavy Timber Construction (Type IV, HT): Construction with wood framing members, columns, flooring and roof decks sized in accordance with IBC Section 602.4.

Ignition-Resistant Building Material: Ignition-resistant building materials shall comply with any one of the following:

- Material that complies with the requirements for noncombustible materials in this section.
- Fire-retardant-treated wood labeled for exterior use.
- Roof assemblies containing fire-retardant-treated wood shingles and shakes and classified as Class A roof assemblies.

- Materials currently approved by the California Department of Forestry and Fire Protection, Office of the State Fire Marshal (search categories include 8110-Decking Materials, 8120-Exterior Windows, 8140-Exterior Sidings and Sheathings, 8150-Exterior Doors and 8160-Under Eave).

Log Wall Construction: A type of construction in which exterior walls are constructed of solid wood members and where the smallest horizontal dimension of each solid wood member is at least 6 inches (152 mm).

Noncombustible: As applied to building construction material, a material that, in the form in which it is used, is either one of the following:

1. Material of which no part will ignite and burn when subjected to fire. Any material conforming to ASTM E 136 shall be considered noncombustible within the meaning of this Section.
2. Material having a structural base of noncombustible material as defined in Item A above, with a surfacing material not over 1/8 inch (3.2 mm) thick, which has a flame spread index of 50 or less. Flame spread index as used herein refers to a flame spread index obtained according to tests conducted as specified in ASTM E 84 or UL723.
3. "Noncombustible" does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances or other sources of high temperature shall refer to material conforming to Item A.
4. No material shall be classified as noncombustible that is subject to increase in combustibility or flame spread index, beyond the limits herein established, through the effects of age, moisture or other atmospheric condition.

Some communities address wildfire concerns through a separate set of code standards specific to the Wildland-Urban Interface by adopting a standalone WUI Code –

which is available as part of the International Code family but can also be integrated into the community's land development code for site development issues aside from structural requirements. For more information, see the WUI Code section of this guide.

Extreme Heat

Extreme heat is a weather condition that results in temperatures that are much warmer than average for a particular time and place. According to the Centers for Disease Control and Prevention, extreme heat causes more deaths than any other weather-related hazard. More than 65,000 Americans visit emergency rooms each summer for acute heat illness. To respond to the growing challenges related extreme heat, some communities are implementing strategies to minimize the impacts of extreme heat through building design.

Power outages are commonly associated with extreme heat events because of increased demand on electric grids to run air conditioning systems. When demand threatens to exceed the grid's capacity to supply electricity, utility providers take precautions to reduce strain on the system. Designing building infrastructure to withstand extreme heat events will help alleviate stress on utility infrastructure and avoid electric service interruption.

One cost effective approach is the use of cool surfaces on building roofs. Cool surfaces are measured by how much light they reflect (solar reflectance or "SR") and how efficiently they radiate heat (thermal emittance or "TE"). A cool roofing surface is both highly reflective and highly emissive to reduce the amount of light that is converted into heat and to maximize the amount of heat that is radiated away. High solar reflectance is the most important property of a cool surface. Increasing the reflectance of buildings through white surfaces or other reflective colored surfaces can reduce the temperature of buildings, thereby reducing the demand for cooling the building through mechanical systems. White roofs are typically 30 to 65 degrees Fahrenheit cooler than dark roofs in afternoon sunshine.

Cool Surfaces: *The Cool Roofs and Cool Pavements Toolkit (2012) Developed by the Global Cool Cities Alliance is a valuable resource aimed at helping homeowners and city officials transition to cool roofs and pavements. This toolkit includes technical information about design, costs, and benefits. coolrooftoolkit.org*

Design-Day Values: *The ASHRAE recommends using design-day temperatures that do not exceed, or lower than, 1 percent of the hours in the historical record. If an HVAC system is designed for the most extreme annual conditions on record, the system could be grossly oversized, may not function efficiently, and could have higher initial costs than is necessary. Many facilities can accept the possibility of not maintaining design indoor conditions for a few hours a year to avoid these impacts; however, some facilities, such as hospitals, may elect to use more extreme design-day values due to the critical nature of the spaces and functions occurring in the facility.*

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) developed procedures for calculating building heating and cooling loads (commonly referred to as design-day values) that are referenced by the International Energy Conservation Code (IECC). Design-day describes a period of time with maximum conditions that an HVAC system is designed to accommodate and maintain a desired indoor temperature and humidity. In an extreme heat event, the outside temperature may exceed the design-day value, thereby rending the mechanical systems undersized. Improperly sized cooling equipment may place additional stress on mechanical, electrical, and plumbing systems, resulting in increased stress and demand on public utility infrastructure.
To prepare for extreme heat events, mechanical equipment can be evaluated using elevated design-day criteria. Supplemental systems can also be added to fill the gap of the de-rating due to temperature. Another approach is ensuring there are redundant systems in place that are de-rated for their design intent at operating temperatures.

Note: This language, which was taken from the City of Philadelphia Building Code, can be added to Section 1504 in Chapter 15 of the IBC and Section R905 in Chapter 9 of the IRC:

Roof Reflectance

Roof coverings over conditioned spaces on low-slope roofs (roof slope < 2:12) on newly constructed buildings and additions to existing buildings shall be Energy Star rated as highly reflective.

Exceptions

1. An addition to a roof that supports living vegetation and includes a synthetic, high quality waterproof membrane, drainage layer, soil layer, and light weight medium plants shall be permitted to comprise part or all of the roof area.

Cool Roof Criteria: *There are several entities that have criteria for measuring Solar Reflectance (SR) and Thermal Emissivity (TE). The City of Philadelphia uses the Energy Star rating system while the City of Chicago accepts compliance with either the CRRC standards or labeled as Energy Star qualified.*

- *U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) Energy Star Program*
- *ASTM International*
- *American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)*
- *US Green Building Council's Leadership in Energy and Environmental Design (LEED)*
- *Cool Roof Rating Council (CRRC)*

2. Roof areas used as outdoor recreation space by the occupants of the building.
3. An area including and adjacent to rooftop photovoltaic and solar thermal equipment, totaling not more than three times the area that is covered with such equipment.
4. Any roof, if the amount of rooftop space not subject to exceptions A through C is in the aggregate less than 100 square feet.

Landslide, Mud/Debris Flow, Rockfall

Designing buildings and structures for the direct effects of a landslide, debris flow, or rockfall is not typically cost-effective. However, many improvements can be made to a site to reduce the structural risk to debris flow and/or rockfall. The most effective ways to prevent damages from a gravity-driven movement of earth is to:

- Select non-hillside or stable slope sites for development; (avoidance)
- Construct channels, drainage systems, retention structures, and deflection walls;
- Plant groundcover to stabilize soils;
- Reinforce soils using geo-synthetic materials; and
- Avoid cut and fill building sites.

Most of these can be addressed by land development codes and engineering standards, rather than building codes. The Landslide, Mud/Debris Flow, and Rockfall section of this guide provides guidance for how land movement related hazards can be avoided.

Soil Hazards

As with landslide and other gravitational hazards, mitigating soil hazards can best be achieved through careful site selection, including geotechnical study of the site. In subsidence-prone areas, foundations must be appropriately constructed, and utility lines and connections must be stress-resistant. When retrofitting structures to be more subsidence-resistant, engineering best management practices such as shear walls, geo-fabrics, and earth reinforcement techniques such as dynamic compaction can be used to increase resistance to subsidence damage and to stabilize collapsible soils.

Note: This language, which was taken from Weld County's adopted building code, can be added as a new Section 1805 in Chapter 18 of the IBC:

Foundation Design and Inspection

1. All foundations shall be designed by an architect or engineer licensed by the State of Colorado.

    1. If a site-specific soils report is not provided, an 'open hole' inspection shall be conducted by an architect or engineer licensed by the State of Colorado.
    2. Subsequent to that inspection, a written letter bearing the architect's or engineer's stamp shall be presented to, and approved by, the [*insert jurisdiction name and department*] prior to backfilling around the foundation.

1. An architect or engineer licensed by the State of Colorado may perform all foundation, perimeter drain, dampproof and concrete encased electrode inspections.
    1. Setback and offset distances must first be approved by [*insert jurisdiction name here*] building inspectors, and a stamped letter from the architect or engineer must be received and approved by the [*insert jurisdiction name and department*] prior to any structural inspections on the building.
    2. A stamped letter must state that the architect or engineer did perform the inspections and that the work is consistent with the design drawings for the foundation.

Foundation Requirements to Mitigate Soil Hazards: *To ensure sufficient foundation strength and construction, Weld County requires all foundations to be designed by an architect or engineer licensed by the State of Colorado. If a site specific soils report is not provided, then an 'open hole' inspection conducted by a licensed architect or engineer is required together with a written letter bearing the architect's or engineer's stamp. Prior to backfilling around the foundation, this letter needs to be approved by the Weld County Building Inspection Department.*

Weld County Building Regulations: Section 29-2-20M

Wind Hazards

The key strategy for protecting a building from wind damage is to maintain the structural integrity of the building envelope, including roofs and windows. Bracing roof trusses and gables and using hurricane straps to strengthen the connection between the roof and walls and walls and foundation will help the structure withstand lateral and uplift forces. Chapter 16, Section 1609 of the IBC and Chapter 3, Section 301 of the IRC

establishes general standards based on regional climactic data for the appropriate design of buildings and structures to withstand wind loads.

Winds blowing over mountain ranges or through gorges or river valleys in some regions can develop speeds that are substantially higher than the values indicated on the map. The basic design windspeed map provided in the IBC (Figure 1609.3(1)) and IRC (Figure R301.2(4)A) identifies the Front Range Area as a "special wind region" requiring further examination for unusual wind conditions.

In 2006 the Structural Engineers Association of Colorado (SEAC) prepared a Colorado Front Range Gust Map that several communities have adopted to supplement the basic wind design criteria found in the IBC and IRC. This map is intended provide local communities with area-specific windspeed data to inform the design of buildings and structures in the Front Range area. It is important to note, when selecting basic wind speeds in regions with a diversity of terrain, use of regional climatic data and consultation with a wind engineer or meteorologist is advised.

Site-Specific Windspeed Data: *The Applied Technology Council (ATC) has user-friendly engineering resources and applications available to those seeking windspeed data for a specific site. ATC is a nonprofit corporation that was established in 1973 through the efforts of the Structural Engineers Association of California.*
http://windspeed.atcouncil.org

Larimer and Boulder counties have adopted area-specific windspeed maps depicting wind exposure categories for anticipated wind events.

Note: This language, (similar to those found in Boulder and Larimer Counties), can be used to amend Section 1609.3 in Chapter 16 of the IBC or Section R301.2.1 in Chapter 3 of the IRC:

Basic Windspeed

1. The project engineer may designate exposure based on site specific conditions.
2. The required Wind Design Speed for a project area shall comply with the [*insert name of local windspeed map here*], as amended.

Severe Winter Storm

Chapter 16, Section 1608 of the IBC and Chapter 3, Section 301 of the IRC establishes general standards

based on regional climactic data for the appropriate design of buildings and structures to withstand snow loads. Due to extreme variations for local snowfall amounts throughout most of the mountainous regions of Colorado, The IBC (Figure 1608.2) and IRC (Figure 301.2(4)B) require that site-specific case studies be established to calculate ground snow loads.
In 2016 the Structural Engineers Association of Colorado (SEAC) prepared a Colorado Design Snow Loads study that several communities have adopted to replace the basic snow load design criteria found in the IBC and IRC. This study provides detailed statistical analysis that aims to achieve uniform resistance against snow loads throughout the entire state of Colorado.
Note: This language can replace Section 1608.2 in Chapter 16 of the IBC:

Snow and Ice on Rooftops: *The article, "Minimizing the Adverse Effects of Snow and Ice on Roofs" released by research engineers with the Cold Regions Research and Engineering Laboratory (CRREL) provides additional information for how building design can minimize adverse effects of snow drifting, sliding snow, ice damming, and snow ingestion. Serving the Corps of Engineers team, CRREL is known for its multi-disciplinary research to help solve scientific and engineering challenges in cold and complex environments.*
erdc.usace.army.mil

Ground Snow Loads

Snow loads shall be determined by the building official using the [*insert jurisdiction snow load map name here*], as amended. Snow loads are based upon the report, "2016 Colorado Design Snow Loads," prepared by the Structural Engineers Association of Colorado (SEAC) Snow Load Committee, April 2016.

Power outages are also associated with severe winter storms. Heat sources and other critical building infrastructure may be compromised during these events. Elevating building insulation standards helps to prevent heat loss during extreme cold, but in order to maintain comfortable temperatures for extended periods of time, primary or supplemental heating systems need to be operational in some capacity. In 2014, FEMA released a report (FEMA P-1019) outlining best practices for improving reliability of emergency power systems during severe natural hazard events. While the report primarily focuses on critical facilities (hospitals, rescue stations, emergency shelters, communications facilities, etc.), these concepts and principles could be modified to apply to other facilities and buildings.

Earthquake

There are several ways in which building codes can improve a building's resistance to seismic events. The primary focus of earthquake design is ensuring that people can safely exit a building following an earthquake. While implementing additional design measures may allow buildings to better withstand the effects of an earthquake, they are not always intended to ensure full functionality of a building following an event. Implementing earthquake resilient construction practices can be accomplished through a variety of structural engineering measures or structural components (e.g., shear walls, braced frames, moment resisting frames, diaphragms, base isolation, energy dissipating devices such as visco-elastic dampers, elastomeric dampers, and hysteretic-loop dampers, and bracing of nonstructural components). More simple building techniques can also be used including avoiding soft stories (a multi-story building in which one or more floors have windows, wide doors, large unobstructed commercial spaces, or other openings in places where a shear wall would normally be required for stability) and bolting the sill plate of houses to the foundation.

The IBC establishes "seismic design categories" based on the spectral accelerations as mapped by the USGS and the site soils classification as determined by a geotechnical engineer. The seismic design category increases in seismic resistance as a function of a letter, seismic design category "A" is the least seismic resistant while category "F" is the highest. The most common mitigation technique used by communities to address seismic events is to require the minimum seismic design category for all types of buildings to exceed that required by the IBC. Benefits and costs of designing to exceed International Code requirements for earthquake depend on several factors including added cost of construction, building economic design life, building replacement cost, and other variables.

Exceeding Seismic Design Standards: *The City and County of Denver has adopted amendments to the IBC requiring all types of buildings to satisfy the requirements of Design Category B as a minimum (See Section 1613). denvergov.org*

Note: This language can be added to Section 1613 in Chapter 16 of the IBC:

Minimum Seismic Design Category

All buildings and structures in [*insert jurisdiction name, specific hazard area, or other identifier here*] shall satisfy the requirements of Seismic Design Category [*insert appropriate category here (A through F)*], as a minimum.

Critical Infrastructure Protection


Source: CASFM

How it Works

A **Critical Infrastructure Protection Plan** is a strategy to make critical infrastructure more resilient. What qualifies as "critical infrastructure" is defined locally, but generally refers to infrastructure that is necessary to providing vital community and individual functions. It can include both buildings (e.g., schools, town halls, hospitals), and also physical facilities such as roads, storm drains, potable water pipes, or a sewer collection system. Critical infrastructure must be designed, located, and sufficiently protected to remain operational during hazard events and emergencies, including floods, wildfires, high winds, and severe weather. Key infrastructure assets can be owned, operated, and maintained by either public agencies (e.g., roads, bridges, water and sewer systems, school facilities, etc.) or the private sector (e.g., hospitals, utilities, etc.). A diminished or vulnerable critical infrastructure system will greatly impede a whole community's ability to withstand or recover sooner from hazard events.

To make these facilities more resilient requires taking actions that removes risk to physical infrastructure. In terms of buildings, examples include: relocation; elevation of the building above the base flood elevation (BFE); dry proofing and wet floodproofing; fire-resistant building materials; and, in some cases, engineered solutions such as levees and floodwalls. In terms of hardening capital facilities, examples include: double sleeving water pipes, elevating roadways prone to flooding above BFE, expanding the capacity of road culverts, removing

physical impediments that restrict water flow in rivers and floodplains, and elevating heating and air conditioning equipment and generators.

Implementation

Each local community must identify and analyze its own critical infrastructure in relation to known hazards and develop a comprehensive strategy. The results should include a list of prioritized capital improvements and associated costs and potential funding sources. The strategy should be incorporated into the local hazard mitigation plan's list of mitigation projects, the local comprehensive plan, and the capital improvement program/plan. It is especially important to develop plans for the long-term maintenance of critical infrastructure, since FEMA (and potentially other agencies) may not provide funding for repair unless the damage is related to a specific disaster event.

Where It's Been Done

Similar to many growing communities in the semi-arid climate of Colorado, the **City of Aurora** faces an increasingly complex future with regard to its water supply and infrastructure planning. Uncertainties related to a host of future conditions including population growth, aging infrastructure, climate change, and extreme events present clear risks to the provision of safe drinking water to its citizens far into the future. As part of developing its 2015 *Integrated Water Master Plan* (IWMP), Aurora Water, the City's water utility, applied a scenario-based planning process in which the potential impacts of these and other factors to its assets were quantified using performance metrics of reliability and resilience. In so doing the City developed a risk management framework to identify key risks inherent to the entire Aurora Water infrastructure system – from watershed supply to storage, treatment, distribution, and delivery. This systematic approach considered the future frequency and severity of drought, wildfire, and floods among other threats and was used to evaluate and rank all the system vulnerabilities to serve as the basis for decisions regarding future capital projects, programs, and policies. Typical of most utilities, Aurora Water's refined Capital Improvement Program outlines projects over the next 20 years. However, despite uncertain future conditions, the planning horizon for their IWMP extends to 2070 with updates planned on a three to five-year basis.

The Erie Municipal Airport, owned and operated by the **Town of Erie**, is located only three miles from its central business district and has long been recognized as critical to the economic well-being of the community. More recently, it was identified by the Town's mitigation planning team as a critical "transportation and lifeline" facility, defined as essential in providing utility or direction either during the response to an emergency or during the recovery operation.

The airport lies in a valley created by Coal Creek, a perennial stream that borders the airport on two sides. One of the facility's most vital infrastructure assets is the Coal Creek crossing, a bridge and culvert system which provides vehicular access to the airport and connects the runway to a maintenance facility, several businesses, and private hangars. The crossing is

also viewed as critical to the success of a proposed Airport Business Park adjacent to the airport. For years, the decaying culvert required frequent clearing and significant repairs just to keep it operational during small storms. In response to these mounting maintenance costs, combined with the recognition of the crossing's high vulnerability to larger flood events which could cause the airport to shut down, the Town replaced the culvert through the assistance of FEMA's Pre-Disaster Mitigation (PDM) program. The construction of two parallel precast concrete box culverts was completed in 2011 for just over $400,000, and soon thereafter the project proved its cost-effectiveness in the wake of the September 2013 flood which resulted in no damage or service interruptions. "The structure worked per its design," said Russell Pennington, Deputy Director of Public Works for the Town of Erie. "It's a great asset to the town and the airport." (*Best Practices*, 2014, p. 8)

Garfield County initiated a long-term *Critical Facilities Protection Plan* (CFPP) in 2015. The County identified the need for such a plan in its local hazard mitigation plan. The County Community Development Department joined with its Emergency Management Department in developing its CFPP. The CFPP is expected to be adopted by the County Commission and integrated into the Garfield County Comprehensive Plan.

Advantages and Key Talking Points

The speed at which a community is able to recover is linked closely to the resilience of its critical infrastructure and ability to avoid damage from disaster. The following steps need to be taken:

- Have a critical facilities protection plan (CFPP) in place prior to any disaster event.
- Establish an on-going program to implement recommended actions in the CFPP.
- Build support for funding of the CFPP by educating the general public and key stakeholder groups.
- Implement the CFPP to achieve long-term savings to the local government, as well as state and federal governments.

Challenges

- Gaining funding support to implement the CFPP can be a struggle when a community has not experienced a disaster for some time.
- Another challenge is avoiding funding competition among agencies responsible for certain infrastructure elements.
- Some critical facilities may also be classified as historic structures, which may introduce additional challenges in terms of upgrading the structures to be more resilient.

Key Facts

Administrative capacity	Planner, public works official, engineer, finance office, emergency manager
Mapping	As needed

Regulatory requirements	N/A
Maintenance	Minimal
Adoption required	Yes
Statutory reference	N/A
Associated costs	Staff time to file for grant(s) – cost can be recovered out of grant(s); to prepare Critical Facilities Protection Plan requires staff time

Examples

City of Aurora Water Department	https://www.auroragov.org/residents/water
Town of Erie Emergency Preparedness	erieco.gov/369/Emergency-Preparedness
Garfield County Emergency Management Department	garfield-county.com/emergency-management

For More Information

Colorado Department of Local Affairs – Financial Assistance
colorado.gov/pacific/dola/financial-assistance

U.S. Office of Infrastructure Protection
https://www.dhs.gov/cisa/national-infrastructure-protection-plan

Silver Jackets Program
silverjackets.nfrmp.us

National Institute of Standards and Technology
Disaster-Resilient Buildings, Infrastructure, and Communities: nist.gov

National Renewable Energy Laboratory
https://www.nrel.gov/

Wildland-Urban Interface Code (WUI Code)


Source: M. Mowery

Hazards Addressed

Wildfire

How it Works

A wildland-urban interface (WUI) code is specifically designed to mitigate the risks from wildfire to life and property. The standards within a WUI code will vary according to the scope that a community is willing to adopt and enforce. Typically, however, a WUI code includes the following topics:

- **Structure density and location**: number of structures allowed in areas at risk from wildfire, plus setbacks (distance between structures and distance between other features such as slopes).
- **Building materials and construction**: roof assembly and covering, eaves, vents, gutters, exterior walls, windows, non-combustible building materials, and non-combustible surface.
- **Vegetation management:** tree thinning, spacing, limbing, and trimming; removal of any vegetation growing under tree canopies (typically referred to as “ladder fuels”), surface vegetation removal, and brush clearance; vegetation conversion, fuel modifications, and landscaping.
- **Emergency vehicle access:** driveways, turnarounds, emergency access roads, marking of roads, and property address markers.
- **Water supply:** approved water sources and adequate water supply.
- **Fire protection**: automatic sprinkler system, spark arresters, and propane tank storage.

A WUI code must also state where it applies. The method to determine applicability is at the discretion of the jurisdiction and may be tied to one or more of the following:

1. All new construction, remodels, and retrofits (including subdivisions and planned unit developments).
2. Broadly defined area at risk to wildfire, such as a WUI boundary map and/or definition.
3. Designated overlay zone other than a WUI (such as a hillside overlay zone).
4. Parcel map that shows individual hazard ratings as determined by the jurisdiction.
5. Hazard rating based on professional site assessment.

A WUI code can also specify under what conditions additional standards may be required. For example, if a site visit determines that the hazard rating is above a certain threshold (e.g., high, very high, or extreme), the jurisdiction may require increased defensible space, an automatic sprinkler system, and a secondary emergency access in addition to the base level WUI code requirements.

Implementation

A WUI code often works in conjunction with other codes, such as the jurisdiction's fire code and building code. References to these other codes should be included in the WUI code. The local authority responsible for a WUI code is typically the local fire district/department, land use department, or building department. To be successful, the adopting jurisdiction should ensure there is enough internal capacity to enforce the code.

Model WUI codes can be useful in providing jurisdictions with examples of language for required mitigation and guidance. It is rare that jurisdictions adopt model WUI codes in full; rather, they adopt them in part and/or with local amendments. WUI codes also work best in concert with other voluntary and outreach programs that encourage resident awareness and education.

Where It's Been Done

In 2012, **Colorado Springs** updated their WUI mitigation requirements by adopting an appendix for the Hillside Overlay Zone that required additional fuels management, fire protection systems, roof coverings, and other hardened structure features.

Some communities and counties in Colorado have adopted either their own WUI code or parts of the International Code Council's Wildland-Urban Interface model code (IWUIC). For example, in 2011 **Pueblo County** adopted most of the IWUIC (2009 edition) as part of their uniform fire code (adopted as the "Fire Codes of Pueblo County").

Many other jurisdictions, including **Boulder County**, **Eagle County**, and **Summit County** have integrated wildfire hazard mitigation requirements into their land use regulations and building codes to specify when new construction, additions, or retrofits require additional mitigation. *For more examples related to wildfire, see additional examples in the Building Code and Site-Specific Hazard Assessment tools.*

Advantages and Key Talking Points

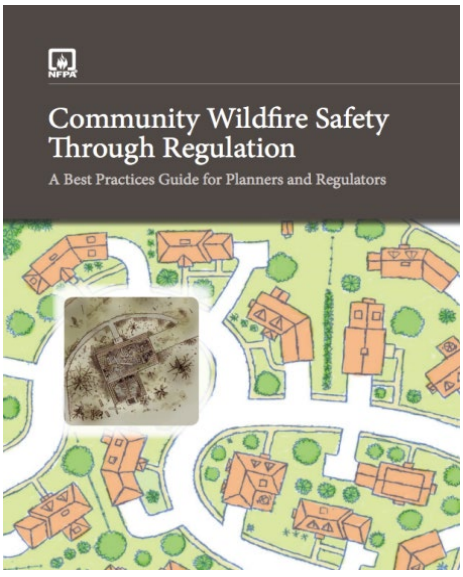
Implementing a WUI code promotes safer development by ensuring that life and property are uniformly protected from wildfire risk. In addition, WUI codes:

- Provide a robust, comprehensive, and consolidated set of regulations for developers, contractors, and residents.
- Complement existing building and fire codes to ensure that additional standards are met.
- Are based on scientific findings on the effectiveness of ignition loss reduction.
- While some WUI code requirements may require more upfront financial investment through the building and construction process, codes can reduce long term spending on suppression and rebuilding because features are built to a higher standard and increase a structure's survivability.
- WUI codes promote safer development that protects life and property.

Challenges

WUI codes can also bring a number of challenges, although many of these can be overcome if the community is committed to the process:

- May bring additional costs to construction, although this varies by jurisdiction.



This 24-page guide by NFPA provides information on community wildfire safety specifically for planners and regulators.

Source: nfpa.org/safety-information/for-consumers/outdoors/wildland-fires/reports-case-studies-and-guides

- Typically WUI codes only apply to new development and improvements or repairs, leaving existing development still at risk.
- Adoption can be controversial; successful WUI code adoptions engage a number of stakeholders and the public long before the adoption process began.
- Enforcement can be challenging and requires adequate internal staff capacity to effectively implement.

Key Facts

Administrative capacity	Experienced planner; coordination with local fire authority and building department
Mapping	WUI map or hazard ratings required for applicability
Regulatory requirements	N/A
Maintenance	Yes. Periodic updating encouraged for maps and technical standards
Adoption required	Yes. Can be integrated into zoning code
Statutory reference	N/A
Associated costs	Varies; may require consultant

Examples

Boulder County WUI Code	http://www.dora.state.co.us/taskforce/Documents/ArticlesStudies/SummaryofBoulderCountyLand_UseWUI_BuildingCodesandtheFourmileCanyonFire.pdf
City of Colorado Springs WUI Code	dora.state.co.us/taskforce/FieldTrip/WUI%20Mitigation%20Ordinance.pdf
Eagle County WUI Code	Chapter 4.07- Development Standards: Fire Protection: https://www.townofeagle.org/DocumentCenter/View/12107/Chapter-407 Chapter 4.13- Subdivision Design, Improvements and dedications: Fire Protection: https://www.townofeagle.org/DocumentCenter/View/12097/Chapter-413
Pueblo County WUI Code	pueblo.org/government/county/code/title8/chapter8-16
Town of Jackson and Teton County, WY WUI Code	http://www.tetonwyo.org/670/Wildland-Urban-Interface-WUI

Kittitas County, WA WUI Code	https://www.co.kittitas.wa.us/cds/firemarshal/wildland-urban-interface.aspx

For More Information

International Code Council Wildland-Urban Interface Code (IWUIC)

Model WUI code: https://codes.iccsafe.org/content/IWUIC2015

National Fire Protection Association

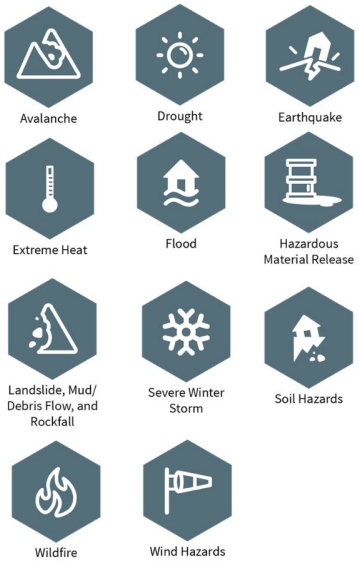
Community Wildfire Safety Through Regulation: A Best Practices Guide for Planners and Regulators: https://www.nfpa.org/~/media/files/public-education/by-topic/wildland/wildfirebestpracticesguide.pdf?la=en

Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1141

Standard for Reducing Structure Ignition Hazards from Wildland Fire: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1144

Capital Improvement Plan (CIP)

Hazards Addressed



How it Works

A **capital improvement plan (CIP)** is a working blueprint for building and sustaining a community's publicly funded physical infrastructure. The purpose of a CIP is to identify capital improvement projects, identify and forecast funding sources, prioritize improvements based on funding available, and estimate a timeline for completion of individual improvements. The CIP links capital expenditures to other long-range plans, such as the comprehensive plan or hazard mitigation plan, and connects community goals to priorities for public spending.

Capital improvements can significantly impact a community's built and natural environment as they can help guide the trajectory of future growth or change, and can represent a substantial portion of a community's overall public improvements. With the increasing frequency and magnitude of natural hazards, the capital improvement plan provides an important tool that local governments can use to mitigate risk and promote community resilience. CIPs can help facilitate the inclusion of hazard mitigation principles into project identification, prioritization, and design, and to leverage mitigation or recovery funds. CIPs can also help communities to understand how growth has the potential to increase risk, and anticipate and avoid potentially negative outcomes.

This CIP Tool Profile defines capital improvement plans/programs, describes how they might incorporate hazard mitigation principles, and discusses case studies from Colorado and elsewhere in the United States.

What are Capital Improvements?

Capital improvements are major, non-recurring public expenditures. Capital improvements typically refer to physical assets and include the design, purchase, construction, maintenance, or improvement of such public resources as land, buildings, parks, public infrastructure, equipment, and public spaces. Most communities designate a dollar threshold for including projects in the CIP. For example, the City of Aurora's Capital Improvement Program identifies capital needs for projects of $25,000 or more.

What is a Capital Improvement Plan (or Program)?

A CIP is a community planning and fiscal management tool used to coordinate the location, timing, and financing of capital improvements. A CIP identifies a community's capital needs over a multi-year period, typically 3-7 years, and lays out a plan for capital expenditures over that time period. Most plans systematically evaluate the availability and use of capital resources according to a prioritization scheme, identify infrastructure improvements that could be funded with resources available, and inform the public about the timetable for the construction or completion of projects. CIPs often include both a comprehensive list of infrastructure needs and a fiscally-constrained plan that is limited by the funding available. CIPs are revised on a regular basis to continually reflect the needs and resources of the community and to incorporate unexpected events or opportunities.

While CIPs vary by community, most include at least two basic sections: the capital program and capital budget. The capital program describes the community's capital needs and priorities over the multi-year planning period. The capital budget is the spending plan for capital improvements in the upcoming budget cycle. CIPs are typically developed as standalone plans, or as a section of a community's annual budget.

While the level of detail in a capital improvement plan will vary according to community needs and capacities, many communities follow a similar outline. The basic steps of preparing and implementing a CIP are:

1. Establish the administrative structure

2. Establish the policy framework for the CIP

3. Formulate evaluation criteria to determine capital spending levels and to guide capital project selection

4. Prepare a capital needs assessment

5. Determine the status of previously approved projects and identify new projects

6. Assess the financial capacity of the municipal unit to undertake new capital projects

7. Evaluate funding options

8. Compile, evaluate, and rank project requests and undertake financial programming

9. Adopt a capital program and capital budget

10. Implement and monitor the capital budget and projects

11. Evaluate the CIP process

The Government Finance Officers Association (GFOA) provides up-to-date and detailed policy guidance and best practices for multi-year capital planning and capital project management.

Integrating Hazard Mitigation into Capital Improvement Plans

The incorporation of hazard mitigation goals and priorities into capital improvement plans is an emerging best practice for achieving community resilience. Capital improvement plans and programs typically include important public improvements such as roadways, fire stations, sewer lines, water supply and storage facilities, wastewater treatment facilities, and other critical infrastructure that are vital to community functioning and warrant careful assessment of hazard risk through the hazard identification and risk assessment process. CIPs are also the primary vehicle through which structural hazard mitigation measures get prioritized and funded. The Federal Emergency Management Agency (FEMA) describes four key benefits to the integration of hazard mitigation into CIPs:

- Leverages funding to implement hazard mitigation measures
- Helps ensure that public expenditures for capital improvements are consistent with hazard mitigation goals, objectives, and policies
- Provides the opportunity to review and consider the impact of proposed improvements on hazard vulnerability, either directly or indirectly, through supporting private investment in land development
- Can help guide new growth to safer areas

At a minimum, FEMA recommends that communities review their CIPs in regards to their connection to hazard mitigation during their regular hazard mitigation plan update. Federal regulations (Title 44 Code of Federal Regulations (CFR) §201.6(c)(4)(ii), Local Mitigation Plans) require that hazard mitigation plans “describe a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans,” when appropriate. FEMA further suggests that CIPs emphasize projects that mitigate the impact of natural hazards by elevating them to high priority, and consider a more unified approach to plan integration by including a staff member who is knowledgeable about hazard mitigation in the development of CIPs.

- In their Plan Integration Guide, FEMA suggests three questions that local communities can ask about their CIPs and Infrastructure Policies to better incorporate hazard mitigation:
- Does the CIP provide funding for hazard mitigation projects identified in the hazard mitigation plan or include mitigation as a component to a redevelopment, renovation, or development project?
- Does the CIP limit or prohibit expenditures on projects that would encourage new development or additional development in areas vulnerable to natural hazards?
- Does your community have infrastructure policies that limit extension of existing infrastructure, facilities, and/or services that would encourage development in areas vulnerable to natural hazards?

The Government Finance Officers Association provides further guidance, recommending that jurisdictions "prepare a comprehensive inventory of its physical assets, create a system to determine critical assets and respective resiliency, and establish a scoring system that evaluates levels of resiliency." The scoring system would then be used to prioritize resiliency needs and capabilities

Where It's Been Done

Fort Collins has historically been at high-risk from flood events, including a 1997 flash flood that killed 5 people and caused over $200 million in damage. Since then, the City has worked to reduce flood risk through structural and non-structural measures including proactive floodplain management; acquisition of high-risk structures; preserving and protecting riparian areas along Spring Creek, Fossil Creek, and the Cache la Poudre River; and discouraging development in high hazard areas.

Fort Collins defines capital improvements as projects with relatively high monetary value, a long life, and that result in the creation of a fixed asset or revitalization that upgrades or extends the useful life of a fixed asset. Along with major commitments to stormwater management projects, the City's CIP also prioritizes projects with hazard mitigation relevance like open space acquisition and critical infrastructure enhancements. The CIP prioritization process rates projects on two tiers of criteria, the first including safety mandates and the second linkages to City approved plans. City Plan Fort Collins, adopted in 2011, includes flood risk reduction and management in its vision and key principles. The plan includes numerous principles and policies centered on the protection of the natural floodplain and waterways; the encouragement of development outside of floodplains; and requirement that structures and facilities that are unavoidably located in flood-prone areas be designed to high standards. By linking its capital improvements prioritization criteria directly to its plans that prioritize flood risk reduction, the City is able to use its CIP to accomplish key flood risk-reduction goals.

Baltimore, Maryland is highly vulnerable to a range of natural hazards including coastal storms, flooding, heat-waves, and severe winter storms. Much of the City's infrastructure is at risk from natural hazards and future climate change, and over the past decade, capital improvements have represented 15-30% of the total City budget. Baltimore has used its CIP program to help achieve resiliency goals. For example, the city's utilities actively use scheduled repairs and capital improvement projects as an opportunity to achieve goals described in the City's Disaster Preparedness Plan and Climate Action Plan. The City's Planning Department also evaluates capital requests according to a range of criteria, including whether the project protects the public's health and safety, and how well it implements the City's Sustainability Plan, which includes elements of hazard mitigation and climate adaptation.

The **City of New Orleans**, which was devastated by Hurricanes Katrina and Rita in 2005, has made resiliency a core principal of its recovery and future development. In 2015, on the 10-year anniversary of Katrina, New Orleans published its first resilience strategy, with the vision of being an adaptable, connected, and prepared city. The City's focus on resilience extends to its adopted capital improvement plan (2017-2021), which describes over $2.4 billion in spending over a 5-year period. Many of those projects have an explicit focus on recovery from Katrina and reducing future flood risk, such as upgrading the citywide stormwater management system, creating a resilience district, and improving parks and open spaces to serve as flood control areas. The plan prioritizes projects that leverage significant disaster mitigation, recovery, and resilience resources from FEMA, HUD, and other federal and state sources.

To help meet its resilience goals, the City of New Orleans has established a Resilience Design Review Committee, which conducts regular reviews of all construction projects funded under resilience programs and/or those related to stormwater management or green infrastructure. The Committee reviews projects according to multiple resilience performance criteria and advises the Chief Resilience Officer at an early enough stage to affect design and planning objectives.

Advantages and Key Talking Points

As a core community planning and fiscal management document for communities, there are numerous advantages to incorporating hazard mitigation into CIPs:

- CIPs can help translate a community vision into practical action and achieve goals of sustainability and resilience.
- CIPs guide a significant portion of a local government's investments in the community and provide a unique opportunity to build mitigation and resilience criteria into community investment practices.
- CIPs link together other long-range plans, like the comprehensive plan and hazard mitigation plan, and the community's capital improvement budget.

- CIPs are developed and updated on a regular basis, which allows for the incorporation of best available data about natural hazards into government decision-making.
- Incorporating hazard mitigation into the CIP can help to lower the costs from natural hazards and make more efficient use of community financial resources by reducing the costs to rebuild or repair infrastructure after future disasters.
- The capital improvement planning process typically involves stakeholders from each department of local government and the public, bringing together a broad base of support for achieving hazard mitigation goals and objectives.

Challenges

The following can be challenges associated with CIPs.

- Developing and updating a CIP can be a time-intensive process, and incorporating hazard planning can add additional complexity.
- Incorporating hazard mitigation into CIPs is an emerging best practice, and so relatively few resources or tools are available to guide local government efforts.
- Many capital plans for publically funded improvements are already restricted by the limited funds available for implementation. The increasingly urgent need for the maintenance and replacement of basic infrastructure often takes precedence over improvements unless directly related to the health and safety of the public.
- In some instances, the up-front costs of projects that incorporate hazard mitigation may increase, even if long-term savings will be achieved.
- The integration of strong hazard mitigation principles into CIPs may be seen as anti-development if it restricts or discourages building in high-hazard areas.

Key Facts

Administrative capacity	A public official typically coordinates the preparation of the CIP – whether a planner, chief executive, administrative officer, or budget officer – with support from a lead department and from other agencies like public works, finance, engineering, and/or public safety
Mapping	Some technical mapping and GIS analysis may be required for integrating hazard areas into the project prioritization process
Regulatory requirements	N/A
Maintenance	CIPs cover a multi-year period, typically 3-7 years, and are reviewed and updated on an annual basis
Adoption required	Yes, adopted by the legislative body of the community following public review

Statutory reference	The Colorado Revised Statutes provide local governments with financial powers to raise revenue for the purposes of capital improvements, and require that proposed expenditures for capital projects be included in annual budgets.
Associated costs	Staff time, plus potential costs for mapping or other technical work, public outreach activities, and consultant services

Examples

City of Baltimore Capital Improvement Program	https://planning.baltimorecity.gov/planning-capital-improvement Also, you can read their Disaster Preparedness Plan here: http://www.baltimoresustainability.org/plans/disaster-preparedness-plan/
City of Fort Collins Capital Improvements Program (within the Comprehensive Plan)	https://www.fcgov.com/planfortcollins/pdf/cityplan.pdf?1415894776
City of New Orleans, LA Capital Improvement	https://www.nola.gov/city-planning/capital-improvement-plan/ Also see the Plan-Resilience Strategy: http://resilientnola.org/ Resilience Design Review Strategy Committee: https://www.nola.gov/resilience/designreview/ Urban Water Plan: https://livingwithwater.com/

For More Information

American Planning Association. Hazard Mitigation: Best Practices Into Planning.
https://www.planning.org/publications/report/9026884/

American Planning Association. Building Coastal Resilience Through Capital Improvements Planning. Berke, Phil, Gavin Smith, and Ward Lyles (2016).
http://mitigationguide.org/

Center for Land Use Education. Planning Implementation Tools: Capital Improvement Plan.

https://www.uwsp.edu/cnr-ap/clue/Documents/PlanImplementation/Capital_Improvement_Plan.pdf

FEMA. Integrating Hazard Mitigation into Local Planning
https://www.fema.gov/media-library-data/20130726-1908-25045-0016/integrating_hazmit.pdf

FEMA. Plan Integration: Linking Local Planning Efforts
https://www.fema.gov/media-library-data/1440522008134-ddb097cc285bf741986b48fdcef31c6e/R3_Plan_Integration_0812_508.pdf

FEMA. Francis, Charlie. Capital Improvement Plans 101
https://opengov.com/article/capital-improvement-plans-101

Government Finance Officers Association. The Role of Master Plans in Capital Improvement Planning
https://www.gfoa.org/master-plans-and-capital-improvement-planning

Government Finance Officers Association. Best Practice Recommendations for Disaster Preparedness
https://www.gfoa.org/disaster-preparedness

Enhancing Administration and Procedures

Aside from adopting tools that focus on how and where development takes place, and the degree to which mitigation must occur, communities can also effectively mitigate hazards by adopting carefully crafted administrative procedures. For example, one of the tools highlighted below discusses the importance of establishing comprehensive application submittal requirements to ensure that all interested parties understand the potential hazard-related risks of new development. Making sure local governments obtain reliable and sufficient information early in the review process allows planners and local officials to make informed decisions and ensure safe growth and development.

This section explores two administrative and procedural tools that communities can use to mitigate hazards. Tools profiled include:

- Application Submittal Requirements
- Post-Disaster Building Moratorium

Many of the other tools in this chapter also require the development of effective administrative procedures in order to be fully effective.

Source: Shutterstock, welcomia

Application Submittal Requirements

Source: Town of Frisco

How it Works

Application submittal requirements are the materials that must be submitted to a local government (usually the planning department) to initiate the development review process. Requirements vary from community to community and by type of project. Building a small addition to an existing building may require little more than filling out a brief application, while developing a large new mixed-use project typically requires complex supporting materials that identify uses proposed, the site layout, and building design, among other features. Other requirements might include letters from adjacent property owners demonstrating support of a project and certification of sufficient infrastructure capacity from local utility providers. Submittal requirements are important because they determine what baseline information will be available to help staff and officials make informed decisions about how the community grows.

Concerning natural hazards, submittal requirements are an excellent opportunity for a community to obtain baseline information about where potentially hazardous conditions may exist on a site—for example, where there are steep slopes, or the boundaries of the floodplain. If hazardous materials are going to be stored or used on the site, the applicant could be required to notify the local government of the type and amount of such materials. Communities may also require development applicants to submit evidence that appropriate mitigation techniques will be employed to offset risk to existing hazards. This evidence can take the form of specialized reports prepared by certified professionals, such as trained foresters or licensed geologists and/or engineers.

Implementation

To develop or amend application submittal requirements, it is important to work closely with other local government agencies or departments that will be reviewing applications for development. Predictability is the key. When a developer knows exactly what is required for a submittal package, it helps them allocate resources and ultimately meet their bottom line. Problems can arise when the community asks for information that is unanticipated and was not requested as part of the original application.

Application submittal requirements typically specify, at a minimum, the type and format of plans required, the number of copies of required documents, applicable fees, proof of ownership, and required signatures. Although some communities include submittal requirements in their zoning and development ordinances, this information is best left outside the ordinances and put online and in the planning department offices, allowing them to be updated over time without ordinance amendments. Keeping administrative material outside the code also makes for a simpler, more user-friendly code.

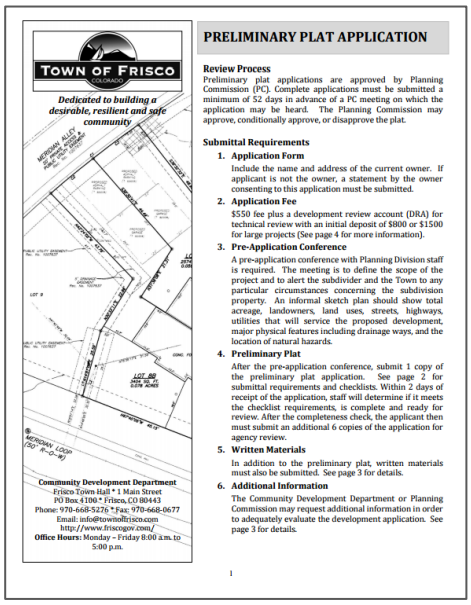
The types of information typically requested to inform the evaluation of development proposals include a map of the proposed development area and a description of existing site characteristics, including geologic, vegetative, topographical, and environmental conditions. If the site is a known or suspected hazard area, communities often require an assessment of whether site characteristics may create a hazard risk, and an analysis of the intensity and character of existing and proposed development and its relationship to the hazard.

Where It's Been Done

The **Town of Frisco** hosts application submittal requirements on a dedicated page on its website. Each procedure includes a form that describes the review and approval process, outlines the application materials required, and includes an online standard PDF form that can be filled out digitally.

For example, for preliminary plats, the department can request geologic investigation reports and soil-type interpretations. These can be used to ensure that future development is feasible within or proximate to known hazard areas.

Frisco's approach makes it clear to developers and other property owners what the expectations are for completing an application. The dedicated webpage is a one-stop-shop; it includes forms for building permits, business-related licenses and permits, planning permits, and water billing forms (*Frisco Forms & Permits*, n.d.).



TOWN OF FRISCO
COLORADO

Dedicated to building a desirable, resilient and safe community

PRELIMINARY PLAT APPLICATION

Review Process
Preliminary plat applications are approved by Planning Commission (PC). Complete applications must be submitted a minimum of 52 days in advance of a PC meeting on which the application may be heard. The Planning Commission may approve, conditionally approve, or disapprove the plat.

Submittal Requirements

1. **Application Form**
   Include the name and address of the current owner. If applicant is not the owner, a statement by the owner consenting to this application must be submitted.
2. **Application Fee**
   $550 fee plus a development review account (DRA) for technical review with an initial deposit of $800 or $1500 for large projects (See page 4 for more information).
3. **Pre-Application Conference**
   A pre-application conference with Planning Division staff is required. The meeting is to define the scope of the project and to alert the subdivider and the Town to any particular circumstances concerning the subdivision property. An informal sketch plan should show total acreage, landowners, land uses, streets, highways, utilities that will service the proposed development, major physical features including drainage ways, and the location of natural hazards.
4. **Preliminary Plat**
   After the pre-application conference, submit 1 copy of the preliminary plat application. See page 2 for submittal requirements and checklists. Within 2 days of receipt of the application, staff will determine if it meets the checklist requirements, is complete and ready for review. After the completeness check, the applicant then must submit an additional 6 copies of the application for agency review.
5. **Written Materials**
   In addition to the preliminary plat, written materials must also be submitted. See page 3 for details.
6. **Additional Information**
   The Community Development Department or Planning Commission may request additional information in order to adequately evaluate the development application. See page 3 for details.

Community Development Department
Frisco Town Hall * 1 Main Street
PO Box 4100 * Frisco, CO 80443
Phone: 970-668-5276 * Fax: 970-668-0677
Email: info@townoffrisco.com
http://www.friscogov.com/
Office Hours: Monday – Friday 8:00 a.m. to 5:00 p.m.

Town of Frisco preliminary plat application submittal requirements information sheet .

Source: Town of Frisco

Estes Park also asks for hazard information to be included in most development applications. The application forms with basic submittal requirements are included on the website, and an appendix to the development code lists all submittal requirements for various types of planning activities. For a subdivision preliminary plat, a map of existing conditions is required with an application and must identify floodplains, topography (including detailed slope analysis), and areas of geologic and wildfire hazards. The development code Section 7.7 is referenced to further describe the requirements for mapping those hazards and implementing proper mitigation techniques (*Development Code*, 2015).

Jefferson County mitigates potential geologic hazards to developments through application requirements outlined in their *Land Development Regulation*. In addition to meeting the adopted standards of hazard identification and mitigation, applicants must provide the County with geologic and geotechnical reports and plans. These documents describe the characteristics of the bedrock, surficial geology, hydrology, and mineral resources of the property, investigate the potential impacts of adverse geologic conditions on the proposed development, and provide methods for hazard mitigation and the abatement of adverse conditions.

Advantages and Key Talking Points

The key benefit to requiring hazard information with development applications is that any issues can be addressed up front, rather than after the project has been through a round of designs. Other benefits include:

- Requiring hazards information with an application submittal makes it clear that minimizing risks to hazards is a priority in the community.
- Benefits property owners over time by reducing potential property damage by minimizing risks to hazards.

- Requiring the applicant to provide evidence of appropriate mitigation relieves staff and local decision-government makers from making judgments that they may not otherwise be trained to make. It also minimizes liability since communities can require evidence to be prepared by licensed professionals (geologists, engineers, foresters, etc.).
- Early identification of potential hazard issues can be dealt with during development review, avoiding awkward opposition during the public hearing process.

Challenges

The amount and type of information required for development applications can be a point of contention among the development community. Developers that work in several jurisdictions are quick to compare the requirements to another community where "development is much easier." Communities that are relatively demanding with applications may run the risk of discouraging development. Planners should ask themselves whether the required information will be used in the decision-making process and is necessary to adequately make a determination of compliance.

Additionally, technical reports and studies can be expensive to produce, so staff should make sure these are necessary for developments during a pre-submittal process. Applicants should not be expected to make large investments in documenting hazard areas and mitigation techniques before they have a sense of whether the project is viable.

Model Code Language and Commentary

Commentary

For any type of development project, most communities have standard rules that control the format and contents of applications. For example, communities specify the type and format of plans required, along with the number of copies needed for supporting documents like maps. Applicants must indicate which local code requirements are applicable to their project, and how they meet the criteria for approval. Applications must be accompanied by required fees, proof of ownership, and contain authorized signatures. Application submittal requirements are typically found with each specific procedure in the zoning ordinance. However, they are often located outside the zoning ordinance and included in an administrative manual or on the local government website. That allows staff to update the application submittal requirements without amending the ordinance.

In addition to these general requirements, applications for projects in hazard-prone areas should be required to include additional materials and/or complete additional steps that are tailored to local conditions and the natural hazard being regulated. These may include:

- Attendance at a pre-application meeting;
- Completion of a site visit;
- Preparation of a site-specific natural hazards map;
- Submission of technical reports; and
- Development of a mitigation plan.

The following sections describe each of these elements and provide standard language that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances and programs from varying communities around the state, including municipalities and counties. The language is

illustrative only; consult local counsel to tailor language for your jurisdiction.

Ideally, submittal requirements should be developed collaboratively by all agencies that will be involved in the ultimate review of the application. Agencies such as the local fire district or flood management agency should be consulted in the initial development of the community's application requirements for projects in hazard-prone areas.

Pre-application Meeting

The language below is a good example of where hazard area maps are called out specifically. This shows the applicant that hazard mitigation and avoidance are critical to the development review process.

A pre-application meeting is required prior to submitting an application for development. Prior to the pre-application meeting, the applicant should consult the official hazard area maps available in the Planning Department to identify any potential hazard areas on the proposed development site.

A. The applicant shall submit a brief description of the existing land use of the site and of the proposed land use and an informal sketch of the existing site prior to the pre-application meeting. The sketch shall show the total acreage of the site, land owners, land uses, streets, highways, utilities, major physical features (rock outcroppings, drainages, etc.), and the location of natural hazards.

B. At the pre-application meeting, planning staff will assist the applicant to determine if a hazard area exists on the property and explain the relevant procedures for review if a hazard area is identified.

C. At the pre-application meeting, planning staff will provide the applicant with a list of the documents, maps, and technical reports required for the application.

D. Following the pre-application meeting, a site visit may be scheduled for planning staff to meet with the applicant at the proposed development site.

Pre-Application Meeting: *The pre-application meeting is an important tool to make sure the applicant is aware that natural hazards may affect the subject property and to identify gaps in the hazard-related information currently available in official maps and reports. Not all hazards can be mapped, but those commonly mapped include flood hazards, wildfire hazards, geologic hazards (landslides, rockfall, and subsidence), avalanche areas, fault zones (earthquake), and hazardous material areas. Applicants can also find hazard maps in the Local Hazard Mitigation Plan, or sometimes in the Comprehensive Plan.*
The meeting also is an opportunity for the applicant and staff to discuss the specific local ordinance requirements that will apply to the development.

Site Visit

When hazards are identified on a development site, a site visit shall be conducted by planning staff to verify the information on the official hazard maps, review the information required for the application process, and discuss mitigation requirements with the applicant.

Site Visit: *Technical staff knowledgeable in the natural hazard may be referenced and included in a site visit to provide more detailed information about mitigation and requirements.*

Site Natural Hazards Map

For all development proposals or land use activities on a site where a natural hazard is identified at the pre-application meeting and confirmed during the site visit, a site map prepared by a licensed geologist or engineer depicting the extent and severity of all identified natural hazards shall be submitted by the applicant to the Planning Department. The site map shall show the extent and severity of the hazard(s) at the particular site. Maps shall be produced at a scale sufficient to determine the nature, extent and severity of the natural hazard. If needed, cross-sections can be used to portray the hazard conditions.

Technical Specialists Should Prepare Maps: *A professional engineer and/or geologist should prepare all maps and technical reports describing and evaluating natural hazards. It is typical for the type of engineer to be specified in the code (e.g., geotechnical engineer for reports on a geologic hazard area). For wildfire hazard reports, a professional forester is usually required to prepare the documents.*

Technical Reports

The local ordinance should specify the types of technical reports and documentation that are necessary to determine the extent of potentially hazardous conditions on the site, the exposure of the site to off-site hazards that could damage land uses on the site, and the risk of causing damage to adjacent properties because of disturbance to the site. The information contained in such reports should be presented clearly and be based on technical site-specific data and surveys. The report should address the potential effects of the hazards on the proposed development in terms of risk and potential damage. Below is a generalized example of the type of technical reports that could be required for review of development in a natural hazard area.

Technical reports prepared by professional engineers and/or geologists are required for all development applications on a site in an identified natural hazard area. Reports and studies required to evaluate the development in the context of known natural hazards will be determined by the Planning Director in

conjunction with the Building Official and Fire District Official. Technical reports may be forwarded to professional experts for review and recommendation. The following information may be required based on the pre-application meeting, the site characteristics, type of development proposed, surrounding land use, and environmental conditions.

Technical Reports: *Some communities include a list of very specific technical data requirements in the zoning code itself. Another, more common approach is identify technical reports in a general way in the zoning ordinance and remove specific details (such as scale requirements for maps) to an administrative manual, user's guide, or handouts outside the code. This allows the technical specifications to be updated and kept current by staff without having to make frequent ordinance amendments.*
Smaller communities with limited staff can work with local subject matter experts or other jurisdictions (such as the County or the Colorado Geologic Survey) to determine whether technical reports should be required as part of a development application.

A. Geologic Hazard Report

1. An index map showing the general location of the development area and its relationship to surrounding topographic features.
2. A map showing the location, nature, and density of the proposed development or land use activity. The map should be at a scale sufficiently detailed to meet the objectives to evaluate the scope of the geologic hazard in relation to the development.
3. On-site soils investigation if in a soils hazard area.
4. Geologic hazard map showing geologic, hydrologic, soil, and topographic features relating to the geologic hazard and geologic cross-sections if needed.
5. Site history describing any prior grading, soil instability, or slope failure.
6. A site evaluation explaining all maps and technical data and describing the suitability of the site to accommodate the proposed development or land use activity.

B. Wildfire Hazard Report

1. A map showing the extent and severity of the wildfire hazard at the particular site.
2. A site map showing existing vegetation on the site.
3. A site evaluation describing the potential for wildfire on the site and the potential for wildfire to spread from the site to surrounding property and vegetation.

C. Flood Hazard Report

1. A report detailing all hydrologic and hydraulic calculations used in preparing maps and plans, or an acceptable floodplain study report prepared

by a recognized agency such as the Federal Insurance Administration or Colorado Water Conservation Board (CWCB).

2. Elevation (in relation to mean sea level) of the lowest floor (including basement) of all new and substantially improved structures.
3. Elevation (in relation to mean sea level) to which any nonresidential structure shall be floodproofed.
4. A certificate from a registered Colorado Professional Engineer or architect that the nonresidential floodproofed structure shall meet the floodproofing criteria contained in the development standards section of this code.

Mitigation Plan

A mitigation plan identifies specific recommendations for the development of a site in a natural hazard area to reduce the risk from the identified natural hazard. These may include building construction techniques and building material specifications. They may direct site layout and installation of landscaping and vegetation or other on-site mitigation measures (such as placement of water cisterns in wildfire hazards). Mitigation plans are usually prepared as part of the technical reports described above. The site plan and accompanying development agreements for the proposed development must incorporate the mitigation plan in order for the development to be permitted.

Mitigation Plans: *Mitigation plans should be made part of the development approval, either through recordation of the plan or inclusion of the plan requirements in required site plans or development agreements. Or they may end up being included in other approval instruments, such as a condition of approval in a Board of County Commissioners or City Council resolution.*

Examples of mitigation plans vary widely by community, by type of hazard, and by type of development. Reviewing authorities frequently require additional site-specific mitigation techniques to be added to a mitigation plan prior to approving the development. Below are two examples of the type of information that could be required in a mitigation plan.

A. Wildfire Hazard Mitigation Plan

When new development or land use activity is proposed within a wildfire hazard area, the applicant shall be required to submit a mitigation plan addressing how the

development or subdivision will either avoid or mitigate the hazard, as more fully set forth below.

1. Mitigation plans shall be prepared by a professional forester according to generally accepted wildland-urban interface protection standards.
2. The mitigation plan shall recommend how to design, manage, and maintain the proposed development or land use activity to adequately mitigate wildfire hazard, including any mitigation for construction activities. The plan shall describe how the recommendations reduce wildfire hazard levels.
3. The plan shall address site vegetation as well as existing and proposed on-site structures, access and emergency fire access.
4. Mitigation methods may include, but are not limited to:
    a. Specific requirements for construction, location and density of structures and lots;
    b. Provision of defensible space;
    c. Specific requirements for alteration to the vegetative features of the land; and
    d. Specific requirements for emergency access and water system capacity.

B. Geologic Hazard Mitigation Plan

When new development or land use activity is proposed within a geologic hazard area, the applicant shall be required to submit a mitigation plan addressing how the development or land use activity will either avoid or mitigate the hazard, as more fully set forth below. Licensed professional engineers and/or geologists who are experienced in the engineering specialty (e.g., soils, slope stability) may submit mitigation plans for steep slope and alluvial soils hazards.

1. The mitigation plan shall be prepared by a professional geologist and shall recommend how to design, manage, and maintain the proposed development or land use activity to adequately mitigate the geologic hazard(s), including any mitigation for construction activities.

Other Sources for Mitigation Information: *If the community does not have adopted mitigation or development standards for natural hazard areas, other recognized sources can be referenced. Several communities rely on standards and guidelines published by the Colorado State Forest Service and Colorado Geological Survey for development standards in wildfire and geologic hazard areas.*

2. The plan shall address how the recommendations reduce geologic hazard risks both on and off-site.
3. Alternatives and solutions to abate and/or minimize the adverse geologic hazard conditions on structures, utilities, and roads shall be included in the plan.
4. Mitigation methods may include, but are not limited to:

    a. Avoidance of run-out zones in rock fall hazard areas;
    b. Specific requirements for construction, location, density of structures and/or lots;
    c. Specific requirements for construction of roads; and
    d. Specific requirements for grading and alteration to the physical characteristics of the land.
    e. Mitigation techniques recommended by the Colorado Geological Survey and as published in *"Guidelines and Criteria for* Identification *and Land Use Controls of Geologic Hazard and Mineral Resource Areas, 1974."*

Key Facts

Administrative capacity	Minimal experience but good communication about procedures and review requirements will improve quality of submittal documents received
Mapping	Applications may include a general site map showing known hazard areas (e.g., floodplain)
Regulatory requirements	Land use regulations and/or development permits such as building permits
Maintenance	Forms and submission requirements should be updated as new federal, state or local regulations are adopted
Adoption required	Not required but authorizing a responsible agency or department to develop submittal requirements and forms defines authority and minimizes gaps
Statutory reference	N/A
Associated costs	Minimal staff time

Examples

Town of Estes Park Estes Valley Development Code	https://library.municode.com/CO/estes_valley/codes/development_code?nodeId=CH7GEDEST_S7.7GEWIHAAR Section 7.7
Town of Frisco Flood Hazard Areas and Forms and Permits	https://www.friscogov.com/departments/community-development/planning-division/flood-preparedness/ and https://www.friscogov.com/forms-permits/building-permit-applications/
Jefferson County Land Development Regulations	https://www.jeffco.us/2452/Regulations-Plans Section 25
Larimer County Land Use Code	https://library.municode.com/co/larimer_county/codes/code_of_ordinances?nodeId=PTIILAUSCO_8.0STALDE_8.3HAAR_8.3.8APRE Section 8.3.8
Summit County Zoning Regulations	http://www.co.summit.co.us/DocumentCenter/View/59/DEV4?bidId= Section 4204.02

Post-Disaster Building Moratorium


Source: FEMA/Patsy Lynch

Hazards Addressed

How it Works

A post-disaster moratorium on repairing or rebuilding structures temporarily restricts building activity following a major disaster. Communities have the authority to implement such restrictions post-event. The authorization to enact a moratorium can also be found within a comprehensive recovery ordinance that is adopted prior to a hazard event. Such ordinances typically establish the framework for a variety of post-disaster tasks, such as debris management, stabilization of damaged buildings, identification of other life/safety risks, repair of damaged infrastructure, and mitigation options and funding to rebuild to different standards or to potentially relocate certain uses (Boyd, Hokanson, Johnson, Schwab, & Topping, 2014). A sample model ordinance can be found on the APA website (see additional resources below).

The moratorium may include provisions to address critical issues regarding rebuilding that will be faced by communities in a post-disaster environment. Such provisions should:

- Establish restrictions for repairing and rebuilding structures that are based on damage thresholds.
- Distinguish between permits needed (and associated procedures) for rebuilding and repairing vs. permits for new development.


Aftermath of 2013 flood in Jamestown, CO.

Source: Michael Rieger, FEMA

- Allow the community more time to assess conditions in more severely damaged areas.

Implementation

Post-disaster moratoria on repairing or rebuilding structures are generally implemented through ordinances adopted by local governments. They can be adopted after a disaster; however, the best practice is to adopt before a disaster occurs and include triggers that will indicate when the procedures will need to go into place and how long the moratorium should last.

Where It's Been Done

Following the 2013 floods, **Jamestown** implemented a moratorium on rebuilding and all new permits. The intent of this temporary moratorium was to allow the Town more time to evaluate the physical impacts the flood had on the Town, and to help inform where and under what conditions rebuilding could occur. This temporary suspension of permitting also allowed the Town Board more time to study and consider any necessary changes to the Town's construction and development policies. The moratorium was in place for four months from September 25, 2013, until January 21, 2014 (*Flood Recovery Information*, 2016).

The Town also created a *Rebuilding and Restoration Guide* (2014) that served as a valuable resource to its citizens following the disaster. The guide provided answers to citizens on all elements related to rebuilding.

Boulder County has integrated procedures for establishing a post-disaster rebuilding moratorium into its Land Use Code. The Code contains an entire section titled "Procedures Following Disasters."

Evans issued an emergency ordinance (Ord. 571-13) that imposed a building and development moratorium after the 2013 floods. The moratorium applied to the special flood hazard area and any additional areas flooded during the September floods, for a period of six months.

Advantages and Key Talking Points

The benefits of enacting a post-disaster moratorium include:

- Allowing a community to pause or slow down the permitting and rebuilding process to help ensure appropriate post-disaster rebuilding (and determining what is appropriate ahead of any disaster event).
- Ensuring that community goals for recovery and redevelopment are being met.
- Allowing for necessary mitigation, code changes, and/or policy changes to be fully evaluated and/or implemented before rebuilding takes place.

Challenges

Despite the many benefits, key challenges associated with implementing a post-disaster moratorium on rebuilding and redevelopment are negotiating the political, economic, and developmental pressures associated with such an ordinance.

There will be pressures to rebuild as quickly possible following a major disaster in order to allow citizens to return to the community and to reestablish the economic vitality of the community. Anything seen as an impediment to a quick recovery will likely not be looked upon favorably by disaster victims and the community as a whole. It takes tremendous political will and clear messaging to community members to enact a post-disaster policy such as a moratorium on rebuilding.

Model Code Language and Commentary

While post-disaster moratoria should be tailored to the needs of the individual community, there are some basic components found in most ordinances, including:

- Purpose
- Duration
- Procedures and Permitting

The following sections describe each of the common elements in more detail and provide standard language that can be considered by Colorado local governments. Model language is in blue shading. Commentary is located in *italics* in the column at the right. The model language used in this document is based on several existing ordinances and programs from varying communities around the state and the nation, including municipalities and counties. The language is illustrative only; consult local counsel to tailor language for your jurisdiction.

Purpose

The purpose of this ordinance is to:

A. Authorize the implementation of a building moratorium when the following actions or findings occur:

1. The [*municipality or county*] is declared a disaster area by the Governor of Colorado or the President of the United States;

Commentary

Establishing a Framework: *Adopting moratoria on development activity can be controversial in the wake of a disaster. Community sentiment often leans toward a "return to normalcy," which would include immediate rebuilding efforts. It is best to establish a clear framework for development permit activities before a disaster occurs to allow for thoughtful planning of hazard areas and to ensure that appropriate measures are taken to avoid repetitive losses.*
A proactive ordinance anticipates the steps that should be taken following any major disaster event within the community and can be incorporated directly into a community's land use and development code. A reactive ordinance is adopted immediately following a disaster event and can be more specific to a specific event and a defined hazard area where such event occurred.

2. The [*City Council, Board of County Commissioners, or equivalent*] declares a local state of emergency; or
3. The [*municipality or county*] is unable to maintain acceptable levels of service following an event as determined by the [*City Council, Board of County Commissioners, or equivalent*].

B. Foster appropriate response during and after a disaster, which often require extraordinary actions.

C. Modify development approval procedures to allow property owners to build, repair, or rebuild in a timely, safe, and responsible manner.

Purpose: *Additional information can be included in the purpose and intent statement, such as a description of specific vulnerabilities to natural and/or human-caused hazards. Communities may also consider authorizing a task force or advisory committee that oversees recovery and rebuilding operations. If such entity is established, that should be included in the purpose statement.*

Duration

Any moratorium imposed shall be subject to review by the [*City Council, Board of County Commissioners, or equivalent*] at the earliest possible time, but no later than [*90 days*] after it begins. At that time, the [*City Council, Board of County Commissioners, or equivalent*] shall extend, terminate, or modify the moratorium.

Duration: *The moratorium duration may vary depending on the scale of the disaster. Communities typically do not exceed six months for a moratorium. Local governments should aim to keep the duration as short as possible and consult with their attorneys whether an extended moratorium would be potential grounds for a takings claim.*

Procedures and Permitting

This section describes the procedures for development permits following a major hazard event.

A. Public Notice

Notice of any moratorium shall be posted in the defined location for all other public notices and shall identify the geographic area for which the moratorium is in effect and the review and permitting procedures impacted by such moratorium.

B. Suspension of Development Activity

1. The [*City Council, Board of County Commissioners, or equivalent*] shall have the authority to temporarily suspend the issuance of land use and development permits they administer under the land use code, building code, and any other ordinance where suspension of such permit is deemed necessary and reasonable to protect the public health, safety, and welfare of the community.

Procedures and Permitting: *Communities may also consider adopting regulations for debris removal and hazard abatement through a separate ordinance. Following a major hazard event, debris removal by the local government can be slowed by property owners taking the position that such debris has value. It is important for communities to act decisively to remove debris and mitigate any conditions in the public right-of-way that could be a safety concern.*

2. The suspension of permits may also include applications currently under review. If an application under review is suspended, the applicable review timeframes shall also be suspended until the development activity suspension has been terminated.

C. Deconstruction or Demolition of Damaged Structures

Any deconstruction or structure demolition requires the appropriate permit from the [*building official, planning director, city/county engineer, city/county manager, or equivalent*]. The [*building official, planning director, city/county engineer, city/county manager, or equivalent*] may waive any or all permitting requirements depending on the type of work and the extent of the disaster.

D. Emergency Repairs

Emergency repairs necessary to prevent imminent danger to life or property is exempt from this section except that the property owner shall notify the [*building official, planning director, city/county engineer, city/county manager, or equivalent*] within [*72 hours/one week/10 days/other timeframe*] of the work conducted and shall apply for any required permit as deemed necessary by the [*building official, planning director, city/county engineer, city/county manager, or equivalent*].

Public Notice: *It is important to define a geographic area, zone, or other boundary for which the imposing moratorium applies. For example, a special flood hazard area, a designated burn area, or a larger area if warranted based on the extent of a disaster.*

Key Facts

Administrative capacity	Adoption of the ordinance does not require significant administrative capacity but implementation of the ordinance does, including coordination with the Building Official and Attorney
Mapping	Mapping may potentially be needed to help determine areas where the moratorium should be implemented for a given disaster event
Regulatory requirements	Local ordinance
Maintenance	Not typically required, unless moratorium is continued for an additional and specific period of time
Adoption required	Yes

Statutory reference	In 2007, the Colorado Supreme Court upheld the authority for local governments to adopt emergency ordinances to temporary zoning control under the Land Use Control Enabling Act, citing Droste v. Pitkin County Commissioners (Colo. 2007)
Associated costs	None directly tied to local government other than staff time required for implementation

Examples

Boulder County Land Use Code	https://www.bouldercounty.org/property-and-land/land-use/planning/land-use-code/ Article 19
City of Evans Moratorium Following 2013 Floods	https://www.cml.org/docs/default-source/uploadedfiles/issues/public-safety/emergency-management/flood-ordinance-evans.pdf?sfvrsn=3fb98bcf_0
Town of Jamestown Flood Restoration Recommendations	https://www.epa.gov/sites/production/files/2015-01/documents/jamestown_flood_restoration_recommendations.pdf
Hillsborough County, FL Ordinance to Guide Redevelopment and Mitigation Following a Disaster or Storm Event	https://www.hillsboroughcounty.org/library/hillsborough/media-center/documents/public-works/natural-hazard-planning/0107-redevelopment-and-mitigation-ordinance-9320.pdf

For More Information

American Planning Association: Planning for Post-Disaster Recovery: Next Generation

planning.org/research/postdisaster

Moving Forward

This chapter focuses on how communities can move forward by identifying immediate next steps for assessing risk, pursuing an appropriate set of tools and strategies, and building the case for adoption. This chapter concludes with a summary of available technical and financial resources for initiatives and strategies discussed throughout this guide.

Preparing the Risk Assessment

As described in detail in an earlier chapter, the first step in preparing for hazards is to conduct a local risk assessment. Most Colorado communities follow the guidelines issued by FEMA and the Colorado Division of Homeland Security and Emergency Management. The four recommended steps for preparing a risk assessment are:

- **Describe hazards.** Identify hazards that may affect the community, and then describe the type, location, extent, previous occurrences, and probability of future events.
- **Identify community assets.** Identify the community's assets at risk to hazards. Assets may be categorized generally as people, economy, built environment, and natural environment.
- **Analyze risks.** Evaluate vulnerable assets, describing potential impacts and estimating losses for each hazard through exposure analysis, historical analysis, and/or scenario analysis.
- **Summarize vulnerability.** Document and summarize the community's most significant hazard risks and vulnerabilities in order to inform the mitigation strategy.

Start with What's Available – Don't Reinvent the Wheel

When resources are limited, don't try to reinvent the wheel. Planners and others involved in preparing the risk assessment should first locate relevant local sources that already address local hazards, such as Hazard Mitigation Plans, Community Wildfire Protection Plans, Floodplain Management Plans, and Emergency Operations Plans. Collect and review what is readily available prior to conducting new analysis and content.

Choosing Appropriate Planning Tools and Strategies

Once a community has identified hazards and prepared a risk assessment, planners and officials can begin evaluating their current lineup of planning tools and strategies for mitigating such hazards and risk. New or updated tools should be considered, in particular those discussed earlier in this guide in *Planning Tools and Strategies*. It is important to identify any gaps in mitigation solutions, develop a clear purpose for seeking new tools or strategies, and then consider the merits of proposed solutions. Communities should ask the following questions prior to moving forward with new planning tools and strategies:

- **What hazards are we trying to mitigate?** Does the tool or strategy under consideration adequately mitigate the potential hazard and/or reduce risk?
- **Do we have necessary policies in place to provide community direction?** Has the community provided clear direction that the problem being mitigated is a priority, or that a particular strategy should be pursued?
- **Do we have the required capacity to accomplish this task?** What will it take to complete the job? Do we have the technical, administrative, and financial resources required to make this tool or strategy effective?
- **Do we have buy-in?** Have we educated leadership and the public about the value of particular tools in order to build support? What is the likelihood of a particular tool or strategy getting through the adoption process? Are there other tools that could accomplish similar goals that are more desirable?
- **Could we accomplish multiple community goals with this tool or strategy?** Does this particular tool or strategy help advance the community in ways beyond hazard mitigation? Does the tool mitigate multiple hazards or risks? What are the environmental and economic benefits and costs? Are there any social equity concerns?

Additional considerations are discussed earlier in *Considering Community Context*.

Implementing Planning Tools and Strategies

Required Steps for Implementation

Once the community has selected appropriate planning tools and strategies to mitigate hazards, they should begin to develop a strategy for implementation. Regardless of the specific tool, common steps for implementation include:

- **Identify who to talk to first.** Find the staff or agency most knowledgeable on the subject matter. Work with them to identify potential pitfalls, other stakeholders to include in the process, and necessary steps for the implementation program.
- **Consider whether or not to assemble a team.** Some of the planning tools may require formation of a technical advisory committee or steering committee. Consider whether or not to form such a team, who should serve on that team, and their objectives and scope of work.
- **Identify examples from other communities.** Most land use planning tools and strategies have been tried and tested elsewhere. Unless this particular tool is new, identify other communities (within a similar context where possible) that have either adopted, or tried to adopt a similar tool or strategy. And don't be afraid to call! Phone conversations foster more candid discussions about successes and lessons learned.

***Best Practice:* Charlotte-Mecklenburg County, NC**
Through extensive stakeholder engagement Charlotte-Mecklenburg County, North Carolina, became ***one of the first communities in the nation to delineate floodplains and regulate new development according to future conditions****. Although a highly controversial strategy when first proposed, those who were initially opposed (including developers, realtors, and local businesses) ultimately endorsed the initiative following several years of discussion and information exchange.*

For more information see:
Hazard Mitigation: Integrating Best Practices into Planning, pages 80-81: fema.gov/media-library/assets/documents/19261

- **Identify funding sources.** If the tool or strategy requires financial resources not currently within the budget, it can be helpful to identify grants or other financial mechanisms to help offset those costs before making an "ask" from the general fund. Several funding sources are discussed below in "Available Resources."
- **Develop a timeline for completion.** Knowing how long the implementation process will take is critical to managing human resources, juggling multiple projects, and prioritizing competing interests within the community. Preparing an estimated timeline for completion can also help maintain momentum when key tasks, milestones, and deliverables are noted with assigned responsibilities.

Building the Case

Once an appropriate planning tool or strategy has been selected, it will quickly become important to build the case for any required approvals and its subsequent implementation. In some cases the need for the tool or strategy may be quite apparent, the benefits clearly understood, and general support more easily obtained. However it is more likely that there will be some critical questions, concerns, or outright opposition raised on the path to implementation by key stakeholders, elected officials, and the general citizenry.

Similar to the pursuit of any new planning tool or strategy, success relies heavily on adequate public **engagement** and proper **messaging**. Some tips and examples for each are provided below.

- **Engagement** – The community as a whole, and especially the specific stakeholders who may be affected by the implementation of the tool or strategy, should be provided the opportunity to be engaged early and often. Building a successful case starts with thoughtful, well-organized activities to build awareness, solicit feedback, and align actions with community values prior to a formal public hearing or decision on the proposed planning tool or strategy. Complete transparency and two-way communication with all, including those who may oppose and/or perceive adverse impacts of the proposed measure is essential.
- **Messaging** – Although the methods and mediums for engaging and communicating with people may vary over time, it's important to stick with a consistent, unified message throughout the process of adopting and implementing the tool or strategy. While there may be different aspects to emphasize with different groups, the overall message should be developed with multiple audiences in mind. Research and practice in the hazards planning field suggest that the key points of that message must be kept clear, concise, and repeated time and time again from multiple sources. Start with the "talking points" provided in the tool descriptions in this guide.
- In talking with **elected officials** the message should be tailored to focus on the problems or opportunities to be addressed through the proposed planning tool or strategy, and should include data that supports the message whenever possible. Other key tips include:

***Best Practice:* City of Longmont, Colorado**
As the City of Longmont, Colorado continues to recover and rebuild from major flooding in 2013, it actively keeps the community informed and involved. This includes some creative branding and messaging on its flood information website which contains a section dedicated to "Resilient St. Vrain!" – the City's collective effort to make the community more resilient to future floods. The website includes succinct language, visual aids, and a series of FAQs to provide clarity on all aspects of the initiative.

For more information see:
longmontcolorado.gov/departments/departments-n-z/public-information/flood-information.

Consider what resonates with each local official and their constituents, and address how the proposed measure is specifically linked and can be supportive of their own unique interests or objectives.
Demonstrate how the proposed measure is consistent with and can enhance other community goals. Be certain to link any co-benefits with the broader social, economic, and environmental drivers for the community.
Be prepared to address any costs, including opportunity costs and especially the consequences of inaction. Explain how and defend why the proposed measure is the most practical and feasible alternative considered.

Forming a Network

Leveraging existing networks and forming new professional and community relationships to address a task or topic are useful ways to improve planning outcomes. By enhancing connections between organizations and individuals, networks help strengthen community

capacity, improve communication, develop resources, and better inform and coordinate specific activities through appropriate expertise.

To successfully tap into existing networks or build a new one, first investigate whether any previous collaborative efforts within the community have been formed to address the topic at hand. There's no need to re-invent the wheel, but there may be opportunities to strengthen the spokes. For example, if your community decides to develop a new planning tool or update an existing plan, determine if there is a group already dedicated to this topic, such as a coalition, council, or emergency management working group. Some delicate digging will be required to discover how/if the group was successful, who was involved, and which areas of expertise were adequately represented or missing.

Knowing this information will help identify what type of additional expertise, political leadership, and community input is desired for your community's task. Specifically:

- **Identify subject matter experts.** Identify individuals or organizations that have recently published relevant and useful information. If the topic is broad and sifting through online search results is overwhelming, determine if there is a local, state, or national non-profit dedicated to this topic. Reach out to them to ask for suggestions on any local experts, resources, or other information.
- **Find examples from other communities.** Use the examples provided in this guide. Reach out to state offices and professional associations to learn from other communities. Colorado's State Hazard Mitigation Officer, Colorado Department of Local Affairs, and the Colorado chapter of the American Planning Association may be able to point you to communities who have undertaken similar efforts.
- **Identify best practices and additional resources.** Contact other state agencies, universities, and branches, for example the Colorado State Forest Service, Colorado Geological Survey, and Colorado Association of Stormwater and Floodplain Managers. Depending on your timeframe, attend a local conference where topics of interest will be discussed. For more technical resources, refer to *Available Resources*.
- **Harness political leadership.** Determine who may be necessary to lead this effort at a community-wide level. Determine if a local city council member, county commissioner, or other elected official has demonstrated interest in the issue, or whether the Local Fire Chief, Emergency Services or Development Services Director buy into the effort and have recommendations to connect with others.

Tips on the Network

Be sure everyone in the network has a clear role for engaging in the task, such as a working group member, an expert reviewer, or an advocate/liaison to other groups. Involve those with access to multiple other networks who can serve as intermediaries to organizations such as the fire department, emergency management, government agency staff members, consultants, and others. Finally, keep project goals front and center – conflicts may arise, but having a good facilitator can help navigate these waters and ensure that others' agendas don't derail the primary task.

- **Recruit local champions.** Determine if there are other citizen's advocacy groups, neighborhood groups, or other local champions who may be interested in engaging and supporting this cause. Think about people whom show up to meetings, whom are engaged in a previous plan update, or whom might be willing to rally around a new effort.

The Champion: Putting Local Advocates to Work

Decades of research and practice in hazards management suggest that one of the key factors to achieving successful and sustained community risk reduction is the presence of one or more "local champions." Champions are those influential people who are committed and capable of driving meaningful change within an organization or community. They are often passionate individuals with the skills to understand, communicate, motivate, and engage others in support of achieving their vision or goals—even in the face of obstacles or resistance. For the purposes of advancing community hazard mitigation, there are essentially two types of champions: internal local government employees and external volunteer advocates.

Internal government champions may be elected or executive officials (such as a mayor, county commissioner or town manager) or local agency staff members who have the ability to lead projects, policies, and other initiatives through multiple departments. To be effective, the local government champion must have the knowledge and authority required to enlist the right partners who can provide the leverage needed to drive decisions and actions with the local governing body. For this reason, it is highly advantageous to have local champions at both the appointed and staff levels who are committed to working for hazard risk reduction. Whereas a department head or line staff member may be best positioned to lead the work, an elected or executive official can direct intergovernmental coordination from above, shepherding the involvement of support staff and other resources across various departments to ensure a more comprehensive and cross-sector effort. (Another option communities have pursued is the creation of an executive staff position within the chief executive's office – for example, a "chief resilience officer" who reports directly to the mayor or county/city/town manager.)

External volunteer champions may be equally if not more important to the success of a community's hazard mitigation efforts. In many cases it is those outside of local government who can serve as catalysts for change in local policies, programs, or activities relating to natural hazards. External champions may include representatives of outside groups such as private businesses, local media, non-profit or civic organizations such as environmental foundations or homeowner associations—or they may simply be individual citizens advocating on behalf of other constituents. These non-governmental advocates can be powerful drivers and partners of community risk reduction by enhancing public outreach and engagement in ways that can complement local government action. They can be especially important for smaller communities with minimal staff or limited capability to implement hazard mitigation efforts on their own.

Implementation and Enforcement

An important measure of success for any of the tools profiled in this report is how the tools are ultimately implemented and enforced. In many communities, good ideas are often ignored or forgotten by political leaders because they are not supported by an effective implementation strategy. *The Citizen's Guide to Planning* identifies important concepts to help ensure that ideas are likely to be implemented:

- **Prioritized**. Make sure the steps for implementation are categorized by priority, making it clear to decision-makers and the community what needs to happen to move an idea forward, both in the short and long term.
- **Politically realistic**. Develop a strategy that is responsive to the local political climate. Consider your top priorities from the first step, and ask yourself how to communicate the value to your leaders.

- **Financially realistic**. A good planning tool will account for all costs of implementation, and increases confidence in the community that their local government is being transparent and a good steward of public funds.
- **Time realistic**. Understand that complex tools take time. Be realistic based on current capacity when estimating timelines for implementation.
- **Accountable**. Define responsible parties for implementing a strategy or planning mechanism. For more complex or longer-range projects, provide updates to community leaders on the status of those projects.
- **Understandable to citizens**. Avoid planning jargon, and keep it as short and simple as possible while providing adequate background on the issues and solutions (Duerksen, Dale, & Elliott, 2009).

Once a program, policy, or tool has been adopted, planners must regularly maintain and enforce it. Many communities struggle to balance regulations that are "good ideas" versus those they have the capacity to enforce. That concept should be considered for any planning tool or strategy mentioned in this document.

As John F. Kennedy once said, "There are risks and costs to action. But they are far less than the long range risks of comfortable inaction." Similarly, as stated in the 2010 APA publication, *Hazard Mitigation: Integrating Best Practices into Planning*, "Postponing the confrontation with reality that hazard mitigation planning entails is simply unsound public policy. Tomorrow may be the day when an earthquake strikes, a flood inundates, or an unstable hillside tumbles and falls."

The question local governments need to ask is whether or not to embrace the concept of hazard mitigation to safeguard the health, safety, and welfare of their community—or treat it as another federal mandate that needs to be satisfied.

Local governments do have a choice. Hazard mitigation involves taking sustained action to reduce or eliminate long-term risk to life and property from hazards. The costs of inaction may be disasters, from which taxpayer money is required to recover. Substantial post-disaster funding assistance may be available through federal or state disaster declarations; however, local governments will always share in the costs of disasters—both directly and indirectly.

An independent study by the National Institute of Building Sciences found that every dollar spent on mitigation saves society an average of four dollars (*Natural Hazard Mitigation Saves*, 2005, p. 5). Therefore, it should be seen as a fiduciary responsibility of local government to take the time to thoughtfully consider projects or initiatives that reduce the potential impacts of hazards within their jurisdiction.

Available Resources

This section includes various resources related to the materials presented in this guide. The resources are divided into three main components:

- **Technical assistance.** Where should a community go to access technical assistance for basic planning and implementation tools?
- **Funding sources.** What types of funding are available to communities for implementing planning tools and strategies?
- **Other guides and resources.** What other sources of information exist, like this guide, that might offer additional insight?

Technical Assistance

Colorado Natural Hazards Mitigation Plan

The *Colorado Natural Hazards Mitigation Plan* is the State's FEMA-approved plan that serves as a foundation for the State's program to reduce risks to people, property, and infrastructure from natural hazards. The Plan is administered and updated by the Colorado Division of Homeland Security and Emergency Management. dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan

Silver Jackets

Silver Jackets is a state-led interagency team that brings together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce the risk of flooding and other natural disasters, and to enhance response and recovery efforts when such events do occur. The Colorado Water Conservation Board is the lead state agency and the US Army Corps of Engineers (Omaha District) is the lead federal partner. The Silver Jackets Team Charter for Colorado became official in March 2013. silverjackets.nfrmp.us

The Nature Conservancy – Private Lands Conservation

The Nature Conservancy works with landowners, communities, cooperatives and businesses to establish local groups that can protect land. Some of the main tools applied include land trusts, conservation easements, private reserves, and incentives. nature.org/ourinitiatives/regions/northamerica/unitedstates/colorado/index.htm

Colorado State Forest Service

A comprehensive resource for communities, practitioners, and homeowners on topics related to wildfire mitigation and forest health. This website includes links to funding assistance, Community Wildfire Protection Plans, Colorado Wildfire Risk Assessment Portal (CO-WRAP), and state-specific guidance on wildfire mitigation best practices. csfs.colostate.edu

Fire-Adapted Communities Learning Network

A national learning network of practitioners dedicated to community wildfire risk reduction and resilience, including related issues such as post-fire flooding. The program is administered by the Nature Conservancy and the Watershed Research and Training Center. The Fire-Adapted Communities website includes a blog oriented towards wildfire mitigation and outreach topics and other practitioner resources for fire-adapted communities, including a Fire-Adapted Community Self-Assessment Tool. facnetwork.org

National Disaster Preparedness Training Center

The National Disaster Preparedness Training Center (NDPTC) offers training and education programs at no cost to participating communities. The available courses cover a range of topics relevant to disaster mitigation planning in Colorado. NDPTC is a member of the National Domestic Preparedness Consortium, a FEMA/DHS training partner. ndptc.hawaii.edu

SHELDUS™

Developed by the Hazards & Vulnerability and Research Institute at the University of South Carolina, SHELDUS™ provides a county-level hazard loss data and map set for the U.S. for 18 different natural hazard events types and has been used by some Colorado communities in completing the risk assessments for their local or regional hazard mitigation plans. https://cemhs.asu.edu/sheldus/

Community Planning Assistance for Wildfire Program

Led by Headwaters Economics and Wildfire Planning International, this new program provides communities with increased capacity to address technical planning efforts. As part of this program, community examples provide additional examples of land use planning and regulatory strategies being implemented across the country. headwaterseconomics.org/topic/wildfire

Funding Sources

Many of the land use planning tools and strategies detailed in this guide can be achieved with existing planning staff. However, some funding opportunities are available to support specific efforts. They are briefly described below. Please see the program website for details on grant amounts, scope, funding eligibility, and timeline.

General Land Use Planning

Energy and Mineral Impact Assistance Fund

This fund administered by the Colorado Department of Local Affairs assists political subdivisions (municipalities, counties, school districts, special districts and other political subdivisions, and state agencies) that are socially and/or economically impacted by the development, processing, or energy conversion of minerals and mineral fuels. Eligible projects include, but are not limited to, local government planning, as well as capital projects such as water and sewer improvements, road improvements, construction/improvements to

recreation centers, senior centers and other public facilities, and fire protection buildings and equipment. colorado.gov/pacific/dola/energymineral-impact-assistance-fund-eiaf

Community Development Block Grant – Disaster Recovery (CDBG-DR)

Federal grant funds are provided following presidentially declared disasters to address unmet recovery needs for housing, infrastructure, planning, and economic development. Funds are provided by HUD and are subject to supplemental appropriations by Congress. Eligible activities include a broad range of planning and project activities. The program for the 2012-2013 declared disasters is administered by the Colorado Department of Local Affairs. colorado.gov/pacific/dola/disaster-recovery

Economic Development Administration Planning and Local Technical Assistance Programs

The Economic Development Administration (EDA) has established natural disaster mitigation and resiliency as a national strategic priority for investment. This particular program provides funds to assist with creating regional economic development plans and to strengthen the capacity of local organizations to undertake and promote effective economic development programs, including disaster resiliency plans. eda.gov/funding-opportunities

Natural Resources Grants and Assistance Database

The Colorado State Forest Service (CSFS) Natural Resources Grants and Assistance Database provides a comprehensive list of natural resource grants and assistance programs that promote the health and welfare of Colorado's natural resources. This includes grant opportunities and programs for Colorado residents to implement fuels mitigation and education efforts with the goal of reducing their wildfire risk. The database is free to use. The database offers information on CSFS programs, as well as grant and assistance opportunities sponsored by federal, state, and private organizations for Colorado residents. nrdb.csfs.colostate.edu.

Hazard Mitigation Planning and Projects

FEMA's Hazard Mitigation Assistance Program

The Colorado Division of Homeland Security & Emergency Management (DHSEM), Mitigation and Recovery Section (MARS), administers all Hazard Mitigation Assistance (HMA) programs. Eligible applicants must have a FEMA-approved Local Hazard Mitigation Plan in order to be eligible for HMA grant funds. The following is a brief description of eligible projects under the following programs.

Pre-Disaster Mitigation Grant Program

This program provides funding on a nationally competitive basis for plans and for natural hazards mitigation projects. Eligible activities include Local Hazard Mitigation Plans, property acquisition and demolition, elevation or relocation, minor localized flood reduction projects (i.e., detention ponds, improved culverts, channel stabilization), structural retrofitting of existing buildings, infrastructure retrofits,

construction of tornado safe rooms, and wildfire defensible space or fuels reduction projects.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) program provides funding for flood risk reduction activities. Communities eligible for FMA funding must be participants in the National Flood Insurance Program (NFIP). Eligible activities include property acquisition and demolition, elevation or relocation, and minor localized flood reduction projects.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides Post-Disaster Mitigation (PDM) funding in the event of a presidential disaster declaration. Potential activities funded through HMGP include all eligible PDM activities, in addition to post-disaster code enforcement activities. Contact a DHSEM Mitigation Specialist for more information:

dhsem.state.co.us/emergency-management/mitigation-recovery
dhsem.state.co.us/emergency-management/grant-programs

Public Assistance, Section 406

This is a federal discretionary grant program that provides funds to incorporate hazard mitigation measures into the repair, restoration, and replacement of facilities damaged by presidentially declared disasters. The program, administered by the Colorado Department of Public Safety, Division of Homeland Security & Emergency Management, awards funds from FEMA on a cost reimbursement basis. Eligible hazard mitigation measures must be identified and approved with an eligible Public Assistance (PA) project. dhsem.state.co.us/emergency-management/grant-programs/public-assistance-grant

Emergency Watershed Protection Program

This program, administered by the US Department of Agriculture, Natural Resource and Conservation Service (NRCS), provides federal funds to relieve imminent hazards caused by floods, fires, windstorms, and other natural occurrences. Eligibility is not limited to presidentially declared disasters and includes projects such as stream restoration, correcting damaged drainage facilities, establishing cover on critically eroding lands, repairing flood control structures, and the purchase of floodplain easements.
nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Watershed Rehabilitation Program

This program, administered by the US Department of Agriculture, NRCS, provides funds to help rehabilitate aging dams that are reaching the end of their design lives to address critical public health and safety concerns. Eligible activities include the planning, design, and construction of entire projects. NRCS selects projects based on recent rehabilitation investments and the risks to lives and property if a dam failure would occur.
nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wr

Wildland-Urban Interface Community and Rural Fire Assistance

This program, administered by the US Department of the Interior (Bureau of Land Management), implements the National Fire Plan and assists communities at risk from catastrophic wildfire by providing assistance to develop local capacity and other activities related to assessment and mitigation planning, community and homeowner education, hazardous fuel reduction, local employment, and fire protection. These funds are available to states and local governments at risk as published in the Federal Register, Indian Tribes, public and private education institutions, nonprofit organizations, and rural fire departments serving a community with a population of 10,000 or less in the wildland-urban interface. federalgrantswire.com/wildland-urban-interface-community-and-rural-fire-assistance.html#.VkoEjWSrRhE

Parks and Open Space Planning

Great Outdoors Colorado Planning Grants

This Great Outdoors Colorado (GOCO) grant is designed to help eligible entities develop strategic master plans for outdoor parks and recreation projects, trails, or site-specific plans. Local governments are eligible to apply for Planning Grants. goco.org/grants/apply/planning

Non-Motorized Trails Grant Program

This Colorado Parks and Wildlife Program funds projects for large recreational trail grants, small recreational trail grants, trail planning, and trail support grants. cpw.state.co.us/aboutus/Pages/TrailsGrantsNM.aspx

Colorado Conservation Trust Fund

Forty percent of the net proceeds of the Colorado Lottery are distributed by the Colorado Department of Local Affairs through the Conservation Trust Fund (CTF) to municipalities and counties and other eligible entities for parks, recreation, and open space purposes. CTF funds are distributed quarterly on a per capita basis. Funding can be used for the acquisition, development, and maintenance of new conservation sites or for capital improvements or maintenance for recreational purposes on any public site. colorado.gov/pacific/dola/conservation-trust-fund-ctf

Land Acquisition

The Conservation Fund: Conservation Acquisition

The Conservation Fund's Conservation Acquisition Revolving Fund provides ready capital for acquisition of lands and waters of high conservation value. conservationfund.org/what-we-do/conservation-acquisition/our-revolving-fund

Land and Water Conservation Fund

The Colorado Parks and Wildlife's Land and Water Conservation Fund (LWCF) program features two funding components: 1) a federal program that funds the purchase of land and water areas for conservation and recreation purposes through four federal land management agencies; and 2) a state-managed matching grant program provides funds for planning,

developing and acquiring land and water areas for state and local parks, and recreation facilities. The current policy of the Colorado Parks and Wildlife Commission is to allocate the annual Colorado state-side LWCF apportionment to trail projects that come before the State Recreational Trails Committee as trail grant applications from eligible local government entities and projects sponsored by Colorado Division of Parks and Wildlife. cpw.state.co.us/aboutus/Pages/TrailsLWCF.aspx

Agricultural Conservation Easement Program

This program, administered by the US Department of Agriculture, Natural Resource and Conservation Service (NRCS) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands. Enrollment options for wetland reserve easements include the purchase of permanent easements, 30-year easements, and other term easements for the maximum duration allowed under applicable state laws. nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/acep/?cid=stelprdb1242695

Drought Planning

Water Efficiency Grant Program & Drought Mitigation Planning Grants

This Colorado Water Conservation Board Program provides financial assistance to communities, water providers, and eligible agencies for water conservation-related activities and projects. Eligible entities as well as state and local governments and agencies can receive funding to develop water conservation and drought plans, implement water conservation goals outlined in a water conservation plan, and educate the public about water conservation. cwcb.state.co.us/LoansGrants/water-efficiency-grants/Pages/main.aspx

Awarded through the program, Drought Mitigation Planning Grants are provided specifically to assist water providers or state and local governmental entities in developing drought mitigation and response plans. cwcb.state.co.us/LoansGrants/water-efficiency-grants/Pages/DroughtMitigationPlanningGrants.aspx

WaterSMART Drought Response Program

U.S. Department of Interior Bureau of Reclamation's Drought Response Program supports a proactive approach to drought. It provides assistance to water users for drought contingency planning, including consideration of climate change information and to take actions that will build long-term resiliency to drought. Water users may include individual citizens, industry, and governments. Program areas include: contingency planning, resiliency projects, and emergency response actions. To be eligible, entities must be within a state or tribe that has a current declaration of drought or that has a drought plan on file with Congress. usbr.gov/drought

Watershed and Flood Prevention Operations Program

This program provides funds to plan and implement authorized watershed project plans for the purpose of watershed protection, flood mitigation, soil erosion reduction, and sediment control among other activities. The program is administered by the U.S. Department of Agriculture, NRCS. nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo

Other Guides and Resources

The American Planning Association Hazards Planning Center

The American Planning Association (APA) Hazards Planning Center offers written guides and webinars on hazard mitigation and recovery planning. Notable resources include written guides on integrating hazard mitigation into local planning, planning for wildfires, drought mitigation, and planning for disaster recovery. The Center also offers a quarterly webinar series on hazard mitigation planning. planning.org/nationalcenters/hazards

- Integrating Hazard Mitigation into Local Planning: planning.org/nationalcenters/hazards
- Planning for Wildfires: planning.org/research/wildfires
- Drought Mitigation: planning.org/research/drought
- Planning for Disaster Recovery: planning.org/research/postdisaster
- Quarterly webinar series: planning.org/nationalcenters/hazards/planninginformationexchange

Beyond the Basics: Best Practices in Local Mitigation Planning

Beyond the Basics is based on FEMA's *Local Mitigation Planning Handbook* (2013) (fema.gov/media-library/assets/documents/31598) and includes additional resources on hazard mitigation best practices. *Beyond the Basics* helps local communities to prepare or update their hazard mitigation plan. It was developed by the University of North Carolina at Chapel Hill. mitigationguide.org

Planning for Community Resilience

The Hazard Reduction and Recovery Center at Texas A&M University developed this handbook on the community resilience planning process, including methods for conducting local risk analysis, engaging with communities around risk reduction, and planning tools for nonstructural hazard mitigation and adaptation. It is available at a cost, here: islandpress.org/book/planning-for-community-resilience

The U.S. Climate Resilience Toolkit

The *Climate Resilience Toolkit* outlines a 5-step process for building resilience, tools for analyzing climate risk, and resources for taking action in local communities. toolkit.climate.gov. Developed by the National Oceanic and Atmospheric Administration (NOAA), the Climate Explorer toolkit is an interactive site within the Toolkit that allows users to visualize current and historical data for risk analysis. toolkit.climate.gov/tools/climate-explorer

FEMA Hazard Mitigation Planning Resources

FEMA provides a variety of general resources for those engaged in hazard mitigation planning, including a series focused on integrating mitigation with related planning objectives. fema.gov/hazard-mitigation-planning-resources. One such resource is *Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials* which provides practical guidance on how to incorporate risk reduction strategies into existing local plans, policies, codes, and programs. fema.gov/media-library/assets/documents/31372

Community Resilience Planning Guide for Buildings and Infrastructure Systems

The National Institute of Standards and Technology (NIST) developed this guide to provide a practical and flexible approach to help communities integrate resilience plans into their economic development, zoning, mitigation, and other local planning activities that impact buildings, public utilities and other infrastructure systems. The first version of the Guide was released in October 2015 and may be updated periodically as new best practices and research results become available. nist.gov/el/resilience/guide.cfm

No Adverse Impact Toolkit How-To Guides

The Association of State Floodplain Managers (ASFPM) developed this series of how-to guides that identify tools for incorporating higher standards for floodplain management into local regulations, policies and programs. The guides are broken down by subject matter into compact, usable information communities can apply. floods.org/index.asp?menuID=460

Community Wildfire Safety Through Regulation – A best practices guide for planners and regulators

Developed by the National Fire Protection Association (NFPA), this resource offers planners and public officials technical and legal justifications for adopting wildfire regulations. It also provides communities with tips on choosing the right planning tools and includes best practices used around the country. https://www.nfpa.org/~/media/files/public-education/by-topic/wildland/wildfirebestpracticesguide.pdf?la=en

General Plan Technical Advice Series: Fire Hazard Planning

A technical advisory published in 2015 by the State of California offers land use guidance on wildfire hazard planning requirements and planning mitigation tools. Much of this guidance could be considered best practice for others. This effort was completed by the California Governor's Office of Planning and Research. opr.ca.gov/docs/Final_6.26.15.pdf

Glossary

List of Acronyms

ASCE	American Society of Civil Engineers
CAIC	Colorado Avalanche Information Center
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEHMC	Colorado Earthquake Hazard Mitigation Council
CGS	Colorado Geological Survey
COG	Continuity of Government
COOP	Continuity of Operations Plans
COWRAP	Colorado Wildfire Risk Assessment Portal
CRS	Community Rating System
CSFS	Colorado State Forest Service
CWCB	Colorado Water Conservation Board
CWPP	Community Wildfire Protection Plan
DFIRM	Digital Flood Insurance Rate Map
DHSEM	Division of Homeland Security and Emergency Management
DNR	Department of Natural Resources (Colorado)
DOLA	Department of Local Affairs (Colorado)
DSS	Decision Support System
EPA	Environmental Planning Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Fire Intensity Scale
GIS	Geographic Information Systems
HAZMAT	Hazardous Material
HIRA	Hazard Identification and Risk Assessment
LEPC	Local Emergency Planning Committees
NCDC	National Climatic Data Center

NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NEHRP	National Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
OSHA	Occupational Safety and Health Administration
PDRP	Post-Disaster Recovery (or Redevelopment) Plans
PHMSA	Pipeline and Hazardous Materials Safety Administration
RMIIA	Rocky Mountain Insurance Information Association
SFHA	Special Flood Hazard Areas
SHELDUS	Spatial Hazard Events and Losses Database
SHMO	State Hazard Mitigation Officer
SoVI	Social Vulnerability Index
TDR	Transfer of Development Rights
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WUI	Wildland-Urban Interface

Defined Terms

100-year flood
A flood event that has a one percent chance of occurring in any given year.

1041 regulations
Regulations that allow Colorado local governments to retain control and develop permitting procedures and standards for development and/or projects with statewide impacts beyond their jurisdiction.

500-year flood
A flood event that has a 0.2 percent chance of occurring in any given year.

Avalanche
A mass of snow, ice, and debris, flowing and sliding rapidly down a steep slope.

Avoidance
From a hazard mitigation perspective, planning and acting to eliminate exposure to hazard risk.

Blizzard
A severe winter storm characterized by low temperatures, wind gusts of 35 mph or more, and falling and/or blowing snow that reduces visibility to ¼-mile or less for three or more hours.

Climate plan
A set of strategies intended to guide efforts for reducing greenhouse gas emissions.

Cluster subdivisions
A close grouping of residential properties in a proposed subdivision where the rest of the land is designated for open space, recreation, or agriculture.

Community Rating System (CRS)
The National Flood Insurance Program's voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP's requirements.

Community wildfire protection plan
A plan developed in an area at-risk from wildland fire and involves interested parties, local government, local firefighting agencies, the state agency which oversees forest management, and federal land management agencies.

Comprehensive plan
A plan that expresses a community's overarching vision, goals, objectives, policies, and strategies for future growth, development, and preservation of the community, protection of community assets, and provision of services.

Conductive heat
Heat moving from one solid to another solid that has different temperature when touching each other.

Conservation easements
A restriction placed on a piece of property to protect its associated resources.

Convective heat
Heat transferred by mass motion of a fluid such as air or water when the heated fluid is caused to move away from the source of heat, carrying energy with it.

COWRAP
Colorado Wildfire Risk Assessment Portal provides coarse-scale landscape level wildfire risk designation. Colorado State Forest Service's (CSFS) uses COWRAP as the primary mechanism to deploy risk information and create awareness about wildfire issues across the state.

Debris flow
Mass of water and earth materials where more than half of the solids are larger than sand grains – rocks, stones, boulders – that flow down a stream, ravine, canyon, arroyo, or gulch.

Density bonus
A zoning tool that permits developers to build at higher density than would normally be allowed in exchange for provision of a defined public benefit.

Deposition
The placing of the eroded material in a new location typically initiated by water or wind.

Development agreement
A contract between a local jurisdiction and a property owner that sets the standards and conditions that govern the development of the property.

Disaster Mitigation Act of 2000
Act that requires State, local, and tribal governments, as a condition of receipt of an increased Federal share for hazard mitigation measures, to develop and submit for approval a mitigation plan that outlines processes for identifying the natural hazards, risks, and vulnerabilities of the area under government jurisdiction.

Drought
Shortage of water associated with a lack of precipitation.

Earthquake
Vibrations or shaking that is commonly created when large blocks of the earth's crust move against one another, but can also be caused by volcanic or magmatic activity.

Ember transport
Small pieces of burning vegetation carried over a distance depending on weather conditions, topography, and species of vegetation.

Erosion
Removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice.

Expansive soils
Soils or soft bedrock that increase in volume as they get wet and shrink as they dry out.

Extreme heat
Weather that is "substantially hotter and/or more humid than average for a location at that time of year."

Fire Intensity Scale (FIS)
Used by Colorado Wildfire Risk Assessment Portal (COWRAP) to determine the potential fire intensity for a specified location.

FIRMs
The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps that identify special flood hazard areas.

Flash flood
Isolated, slow-moving thunderstorms with intense but isolated rainfall; the sudden failure or release by a dam, levee, retention basin or other stormwater control facility; or the obstruction of natural flows by ice jam or other blockages that cause backflow and overtopping.

Flood
An overflow of water that accumulates faster than surface absorbency allows or is greater than the normal carrying capacity of the stream channel.

Floodplain
Lands adjacent to rivers, streams, lakes, and other water bodies that periodically flood and is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals.

Future land use map
Illustrations of the desired development patterns and land uses for a community.

Geographic Information Systems (GIS)
A system designed to capture, store, manipulate, analyze, manage, and present all types of special or geographical data.

Geologic hazards
An extreme natural event in the crust of the earth that pose a threat to life and property, e.g., earthquakes, volcanic eruptions, landslides, etc.

Greenhouse gas (GHG)
Gas(es) that contributes to the greenhouse effect by absorbing infrared radiation.

Hazard Identification and Risk Assessment (HIRA)
A community's written evaluation of its risk and vulnerability.

Hazardous material release
The spilling, disposal, or other form of discharge into the environment of any element or compound that, because of handling, storing, processing, or packaging, may have detrimental effects upon the public or environment.

Hazus
A nationally applicable standardized methodology that contains models for estimating potential physical, economic, and social losses from earthquakes, floods, and hurricanes.

Heat index
Measures the "apparent temperature" when considering both air temperature and humidity and is used by organizations like the National Weather Service to identify extreme heat days.

Heavy snow
Snowfall accumulating to four inches or more in depth in 12 hours or less, or snowfall accumulating to six inches or more in depth in 24 hours or less.

High winds
Wind events with sustained wind speeds of 40 mph or greater and lasting for one hour or longer, or winds of 58 mph or greater for any duration.

Homogeneous forest
Forests of the same composition including trees of the same age, size, species etc.

Hydrophobic
Unable to absorb water.

Ice storm
Occasions when damaging accumulations of ice are expected during freezing rain situations.

Land acquisition
Procurement of property.

Landslide
Downward and outward movement of slopes composed of natural rock, soils, artificial fills, or combinations thereof.

Local Hazard Mitigation Plan
Consolidation of hazard-related information prepared by a community, including an assessment of potential hazards and risk, identification of vulnerable populations, and development of mitigation strategies. Local Hazard Mitigation Plans must be approved by state and federal officials and are effective for five years.

Low-impact development
Stormwater management practice with the basic principle of managing rainfall at the source using uniformly distributed decentralized micro-scale controls.

Manufactured housing
A type of prefabricated housing that have similar zoning requirements and rights as stick-built housing.

Mitigation
Sustained action to reduce or eliminate long-term risk to life and property from hazards.

Modified Mercalli scale
A measure of an earthquake's intensity.

Moratorium
A temporary prohibition of an activity.

Mud flow
A mass of water and fine-grained earth materials that flow down a stream, ravine, canyon, arroyo, or gulch.

Overlay zoning
A regulatory tool that creates a special zoning district placed over an existing base zone, thereby having special provisions in additional to existing provisions.

Parks and open space plan
A citywide and/or regional plan for parks, recreation, trails, and open space.

Response and recovery planning
A plan that prepares a city, region, or state to respond to a local hazard with recovery measures in place.

Richter scale
A measure of an earthquake's magnitude.

Risk assessment
Identification of the potential impacts of hazards on a community's physical, social, economic, and environmental assets and description of mitigation measures to reduce future risk.

Riverine erosion
Long-term process whereby riverbanks and riverbeds are worn away.

Rockfall
Newly detached mass of rock falling from a cliff or down a very steep slope.

Safe room
A room or space that is specially anchored and armored to provide near absolute protection during a tornado or wind storm.

Severe thunderstorm
A storm that produces a tornado, winds of at least 58 mph (50 knots), and/or hail at least one inch in diameter.

Special Flood Hazard Areas
Areas where the National Flood Insurance Program's floodplain management regulations must be enforced and areas where the mandatory purchase of flood insurance applies.

Sleet or freezing rain
Pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes.

State Hazard Mitigation Officer
Individual responsible for developing and maintaining the state's disaster-specific hazard mitigation plans.

Stormwater management BMPs
Stormwater management Best Management Practices are implemented at the local level to control the quantity and quality of runoff from land development and is most effective by managing site-specific techniques close to the source.

Stream buffers and setbacks
A vegetated area near a stream which helps shade and partially protect a stream from the impact of adjacent land uses with a key role in increasing water quality.

Subarea plan
Area-specific plans that supplement a jurisdiction-wide comprehensive plan.

Subdivision
The division of land into pieces that are sold or otherwise developed, usually via a plat.

Subsidence
The gradual caving in or sinking of an area of land.

Thunderstorm
The presence of lightning and its resulting thunder usually accompanied by strong winds, heavy rain, and hail, or sometimes no precipitation at all.

Tornado
A localized, violently destructive windstorm occurring over land.

Transfer of development rights
Program that allows landowners to sell development rights from their land to a developer or other interested party who can then use these rights to increase the density of development at another designated location.

Use-specific standards
Requirements that are applied to individual use types regardless of the zoning district in which they are located.

Wildfire
Unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.

Wildland fire
Wildland fire occurs when vegetation, or “fuel,” such as grass, leaf litter, trees, or shrubs, is exposed to an ignition source and the conditions for combustion are met, resulting in fire growth and spread through adjacent vegetation.

Wildland-urban interface (WUI)
A fire burning situation that has transitioned from natural areas on vegetation to a combination of vegetation and the built environment.

Wind erosion
Wind is responsible for land removal, movement, and deposition and most commonly occurs from exposed areas such as fields, tailings, and desert areas.

WUI Code
Codes that are specifically designed to mitigate the risks from wildfire to life and property. WUI codes provide a set of wildfire mitigation development standards, including structure density and location, building materials and construction, vegetation management, emergency vehicle access, water supply, and fire protection.

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Index

Appendix: Hazards in Colorado

This guide describes the individual hazards that may affect communities in Colorado. Information on identifying hazards that may affect individual communities, conducting a risk assessment, and preparing a hazard mitigation plan is in Chapter 3, *Hazard Identification and Risk Assessment*.

Don't Miss These Resources!

The following data sources are the perfect starting point for identifying hazards and assessing risk. Other hazard-specific data sources are included throughout this appendix. More information on each of these resources is included in this guide under "Summary of Common Hazard Data Sources."

1. *Colorado Climate Center: ccc.atmos.colostate.edu*
2. *Colorado Geological Survey: coloradogeologicalsurvey.org*
3. *Colorado Natural Hazards Mitigation Plan: dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan*
4. *Federal Emergency Management Agency: fema.gov/media-library/assets/documents/7251*
5. *National Centers for Environmental Information: ncei.noaa.gov*
6. *National Oceanic and Atmospheric Administration: noaa.gov*
7. *National Weather Service: weather.gov*
8. *United States Geological Survey: usgs.gov*

Source: CDOT

Avalanche

Description

An avalanche is a mass of snow, ice, and debris flowing and sliding rapidly down a steep slope (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-138). An avalanche is defined in Colorado state statutes as a "geologic hazard."

Snow avalanches occur in the high mountains of Colorado seasonally as the result of heavy snow accumulations on steep slopes. When the snow pack becomes unstable, it suddenly releases and rapidly descends downslope either over a wide area or concentrated in an avalanche track. Only part of an avalanche may release at once. Avalanches may reach speeds of up to 200 miles per hour and exert forces great enough to destroy structures and uproot or snap off large trees. They may be preceded by an "air blast," which is a strong rush of air that can measure over 100 mph and is capable of damaging buildings. They are more common with powder avalanches (where snow grains are largely suspended by fluid turbulence) that occur in parts of Colorado.

Avalanche paths consist of a starting zone, a track, and a runout zone. Generally, the runout zone is the critical area for land use decisions because of its otherwise attractive setting for development. Avalanche-prone lands may pass many winters or even decades without a serious avalanche. Lack of vegetation or a predominance of quick-growing aspen and low shrubs often characterize active portions of an avalanche track and the runout zone, readily identifying the area of seasonal peril.

Avalanches can be deadly. Over the past ten years, an average of 28 people per year have died from avalanches in the U.S. (*Statistics and Reporting*, n.d.b) Since records began to be collected in the 1970s, over 990 deaths have been reported as a result of avalanches.

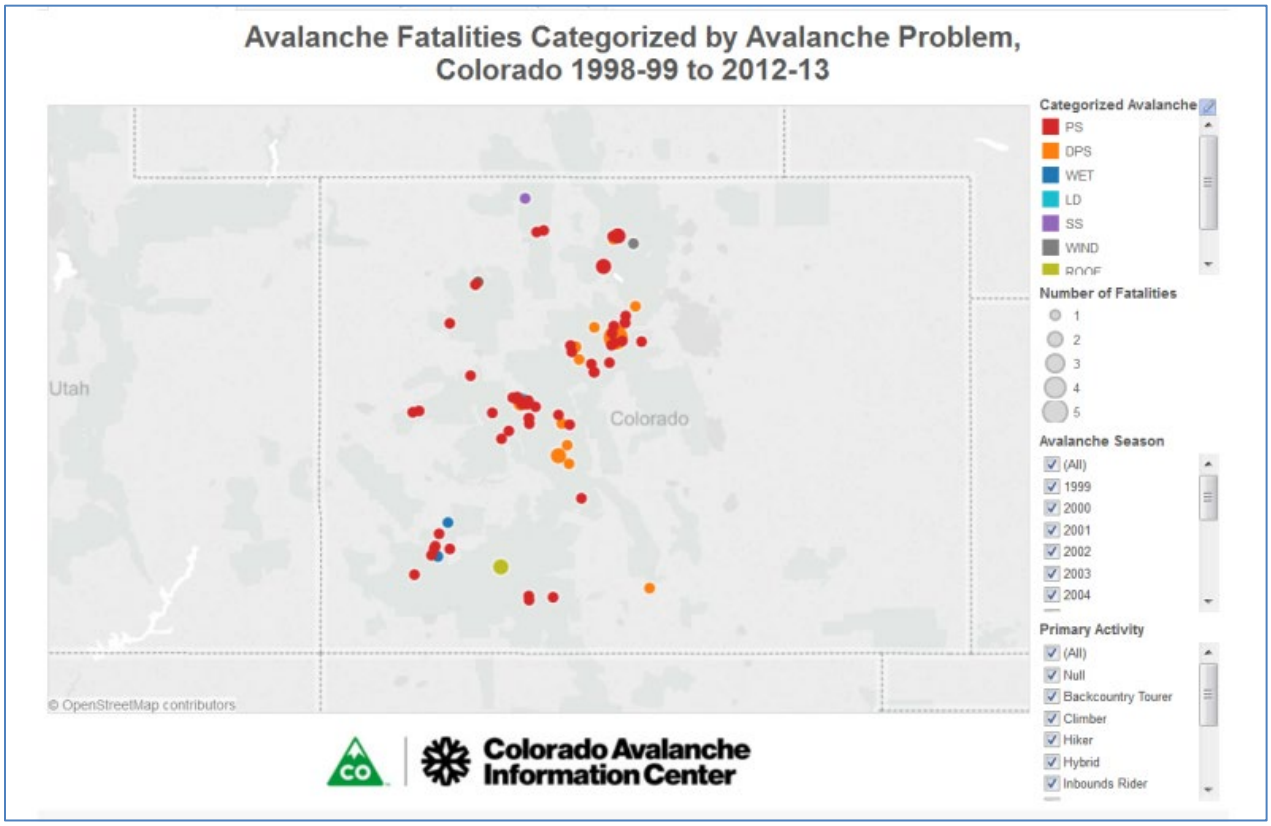
Avalanches in Colorado

According to the Colorado Avalanche Information Center (CAIC), avalanches have killed more people in Colorado than any other natural hazard since 1950, and Colorado accounts for one-third of all avalanche deaths in the United States. Most deaths are backcountry recreationists and they most commonly occur on the steep mountain slopes in Western Colorado between November and April. Recorded property damage is relatively low, with a total of $313,500 over the last 50 years, suggesting good recognition and avoidance of hazardous construction in known runout zones (*Colorado*

Large slab avalanche along U.S. Highway 550 at West Riverside, near Red Mountain Pass, Colorado.

Source: Colorado Geological Survey. Snow Avalanche. Photo by Don Bachman. coloradogeologicalsurvey.org/geologic-hazards/avalanches-snow/definition

Natural Hazards Mitigation Plan, 2013, p. 3-147). However many highways, roads, and railroads intersect with runout zones in Colorado and avalanches remain a constant threat to transportation safety. Road closures are common at various locations across the state due to avalanche threats, damages and cleanup, or mitigation activities. These closures may disrupt commerce and isolate communities with limited road access.



Sample Avalanche Problem Map, available from the Colorado Avalanche Information Center.

Colorado Avalanche Information Center. Statistics and Reporting. avalanche.state.co.us/accidents/statistics-and-reporting

Related Hazards

Avalanches generally occur independently of other hazards, although they are often caused by increased snow pack from winter precipitation. Earthquakes, thermal changes, and blizzards are also likely to trigger avalanches. Avalanche impacts (damaged structures, loss of lives, etc.) can be similar to those resulting from landslides, mud/debris flows, and rockfalls.

Available Data Sources

Colorado Avalanche Information Center (CAIC)

The CAIC is a program within the Colorado Department of Natural Resources. The program is a partnership between the Department of Natural Resources (DNR), Department of Transportation (CDOT), and the Friends of the CAIC (FoCAIC), a 501c3 organization. The

mission of the CAIC is to provide avalanche information, education, and promote research for the protection of life, property, and the enhancement of the state's economy. The CAIC website provides useful information such as statistics, maps, photos, and videos about avalanches. avalanche.state.co.us

The Colorado Department of Transportation (CDOT) Avalanche Atlas

CDOT's Avalanche Atlas contains 522 known avalanche paths across the state. CDOT regularly monitors conditions and implements control measures to help mitigate impacts to state highways. codot.gov/travel/winter-driving/AvControl.html

American Avalanche Association

The American Avalanche Association is a national organization whose mission is to promote and support professionalism and excellence in avalanche safety, education, and research in the United States. The Association provides information about snow and avalanches, provides direction for promoting and supporting avalanche education in the U.S., and promotes research and development in avalanche safety. The Association also provides and exchanges technical information and maintains communication among persons engaged in avalanche activities. americanavalancheassociation.org

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

Applicable Planning Tools and Strategies – Avalanche	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience Planning
Strengthening Incentives	• Development agreement • Density bonus • Transfer of development rights
Protecting Sensitive Areas	• 1041 regulations • Cluster subdivision • Conservation easement • Land acquisition • Overlay zoning
Improving Site Development Standards	• Site-specific assessment • Subdivision and site design standards • Use-specific standards
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	• Application submittal requirements

Drought

Description

The Colorado Water Conservation Board defines "drought" as a shortage of water associated with a lack of precipitation (*Drought*, n.d.c). Compared with sudden-onset hazards like earthquakes or fires, drought hazards often unfold over years, and it may be difficult to quantify when a drought begins or ends.

According to the National Drought Mitigation Center (NDMC), a drought is operationally defined by its various effects:

- *Meteorological drought* is a period of below-average precipitation.
- *Agricultural drought* occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations like livestock.
- *Hydrological drought* is a deficiency in surface and subsurface water supplies, generally measured as stream flow, snow pack, groundwater levels, or the level of lakes and/or reservoirs.
- *Socioeconomic drought* impacts health, well-being, and quality of life, or has an adverse economic impact on a region (*Types of Droughts*, 2016b).

Drought in Colorado

Drought is one of the most serious hazards affecting Colorado (Colorado Water Conservation Board). Colorado's water supply comes entirely from precipitation, in the form of rain, snow, and hail, because there are no major rivers that flow into the state (*State Drought Planning*, n.d.g). With the semiarid conditions in Colorado, drought is a natural part of the climate and can directly or indirectly affect the entire population of the state. Since 2010, every county in the state has experienced drought impacts (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-21). Droughts in Colorado can be short or long-lived, and their impacts come in many forms, particularly in water-intensive sectors such as agriculture, municipal water supplies, recreation, tourism, and wildfire protection.

The 2014 Climate Change in Colorado Report finds that warming temperatures in Colorado have worsened some drought indicators over the past 30 years. The report also predicts that droughts and wildfires will increase in frequency and severity by the mid-21st century because of projected warming (*Climate Change in Colorado*, 2008).

Related Hazards

Droughts are associated with several other hazards in Colorado. They are an ongoing cause of expansive/shrinking soils, subsidence (the gradual sinking of land), and pest infestation. Droughts can also create conditions conducive to wildfires and flash flood events.

Available Data Sources

Colorado Water Conservation Board

- Statewide drought and water supply assessment - cwcb.state.co.us/water-management/drought/Pages/main.aspx
- Drought planning toolbox - cwcb.state.co.us/technical-resources/drought-planning-toolbox/Pages/main.aspx

National Drought Information System

The National Drought Information System operates the U.S. Drought Portal at www.drought.gov, which includes a range of resources made available by the National Drought Policy Commission.

National Drought Mitigation Center

The National Drought Mitigation Center at the University of Nebraska-Lincoln provides a host of information and tools for drought planning and monitoring. drought.unl.edu/AboutUs.aspx. The U.S. Drought Monitor, jointly produced by the National Drought Mitigation Center, the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture, provides current drought condition data for Colorado. https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx

Colorado Drought Mitigation and Response Plan

The Colorado Drought Mitigation and Response Plan (2013) was developed to "provide an effective and systematic means for the State of Colorado to reduce the impacts of water shortages over the short and long term" (p. vii). The plan contains information about drought hazards, drought risk assessment, drought history in Colorado, and potential mitigation actions at the state and local level. cwcb.state.co.us/water-management/drought/Pages/StateDroughtPlanning.aspx

Colorado Climate Center

The Colorado Climate Center at Colorado State University provides numerous resources on drought including evaporation data, precipitation maps, and a drought index. climate.colostate.edu/drought.php

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

Applicable Planning Tools and Strategies – Drought	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience Planning
Strengthening Incentives	*N/A*

Protecting Sensitive Areas	• 1041 regulations
Improving Site Development Standards	• Stormwater ordinance • Subdivision and site design standards • Landscaping Ordinance
Improving Buildings and Infrastructure	• Building code
Enhancing Administration and Enforcement	*N/A*

Earthquake

Description

Earthquakes are the vibrations or shaking created when large blocks of the earth's crust move against one another. The break between these blocks is a "fault." Most earthquakes in the earth's crust occur from movement on faults. Less frequently, some earthquakes are caused by volcanic or magmatic activity (*Colorado Natural Hazards Mitigation Plan*, 2013, p. 3-153).

Magnitude and intensity are terms used to describe seismic activity. Magnitude (M) is a measure of the total energy released. Each earthquake has one magnitude. Intensity (I) is used to describe the effects of the earthquake at a particular place. Intensity differs throughout the area. The Richter Scale is commonly used to measure magnitude, and the Modified Mercalli Intensity Scale (MMI) measures intensity.

The most intense shaking experienced during earthquakes generally occurs near the rupturing fault and decreases with distance away from the fault. In a single earthquake, however, the shaking at one site can easily be 10 times stronger than at another site, even when their distance from the ruptured fault is the same.

Earthquakes in Colorado

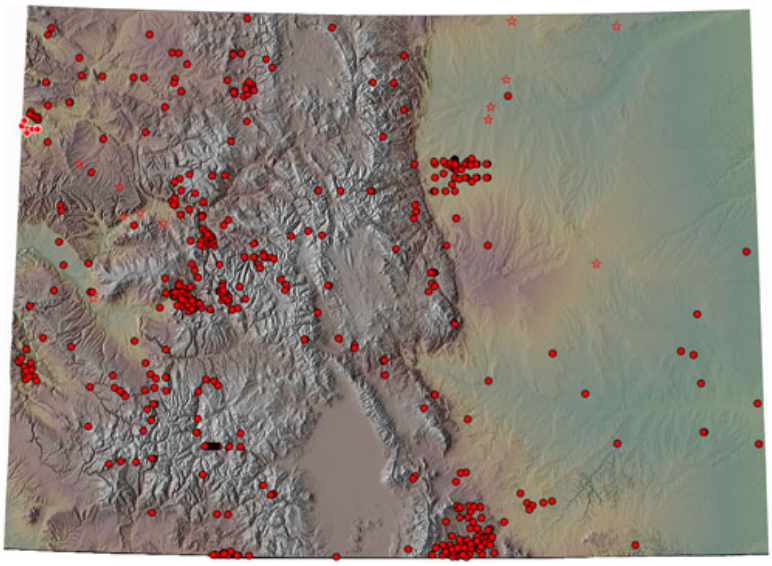
Many earthquakes in Colorado occur naturally; however, they can also be caused by human actions. Humans may trigger earthquakes through different types of activities including oil and gas extraction, reservoir impoundment, fluid injection, or mining.

Although many of Colorado's past earthquakes have occurred in mountainous regions, some have been located in the western valleys and plateau region or east of the mountains. Thousands of faults have been mapped in Colorado, but scientists think only about 90 of these have been active in the past 1.6 million years. Portions of the state have clusters of faults, such as near the Denver metro region, central mountains, and the southwestern and northwestern part of the state. Seismic activity is largely absent in Northeast Colorado.

The Sangre de Cristo Fault, which lies at the base of the Sangre de Cristo Mountains along the eastern edge of the San Luis Valley, and the Sawatch Fault, which runs along the eastern margin of the Sawatch Range, are two of the most prominent potentially active faults in Colorado. Not all of Colorado's potentially active faults are in the mountains. For example,

the Cheraw Fault, which is in the Great Plains in southeast Colorado, appears to have had movement during the recent geologic past. Some faults, such as the Derby Fault near Commerce City, cannot be seen at the earth's surface.

Even though the seismic hazard risk in Colorado is relatively low to moderate compared to other states like California, it is likely that future damaging earthquakes will occur in Colorado. More than 500 earthquake tremors of magnitude 2.5 or higher have been recorded in the state since 1867. More earthquakes of magnitude 2.5 to 3.0 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 time period.)



Historic epicenter locations for earthquakes since 1867.

Source: Colorado Geological Survey. Earthquakes. coloradogeologicalsurvey.org/geologic-hazards/earthquakes-2

The largest known earthquake in Colorado occurred on November 7, 1882, and had an estimated magnitude of 6.5. The location of this earthquake, which has been the subject of much debate and controversy over the years, appears to have been in the northern Front Range west of Fort Collins. The most economically damaging earthquake in Colorado's history occurred on August 9, 1967, in the Denver metropolitan area. This 5.3 magnitude earthquake caused more than $1 million in damages in Denver and the northern suburbs (*Colorado Natural Hazards Mitigation Plan*, 2013, p. 3-159). This earthquake is believed to have been induced by the deep injection of liquid waste into a borehole at Rocky Mountain Arsenal.

More recently, a magnitude 5.3 earthquake occurred on August 23, 2011, causing moderate damage near Segundo and Valdez in southern Colorado. In recent years, seismic activity appears to be on an upward trend in Colorado, with 30 seismic events recorded in 2013 and 44 events recorded in 2014.

Related Hazards

Earthquake events have the potential to trigger avalanches, landslides, soil hazards (liquefaction, uneven ground settling), and flooding caused by the failure of dams, levees or other impoundment structures. Additionally, broken natural gas lines and other pipelines may cause hazardous material releases and often result in structural fires following the event.

Available Data Sources

Colorado Geological Survey

The Colorado Geological Survey is the primary agency for maintaining Colorado earthquake hazard information. coloradogeologicalsurvey.org

- The CGS Earthquake page is a one-stop location for finding more information on Colorado earthquakes. http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/
- The Earthquake Reference Collection is a listing of over 500 earthquakes and faulting events that have taken place in Colorado. http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/earthquake-reference-collection/view-entire-collection/
- The Colorado Earthquake and Late Cenozoic Fault and Fold Map Server is an online map viewer that indicates where fault lines and folds can be found in Colorado. http://coloradogeologicalsurvey.org/colorado-geology/structures/maps/

Unites States Geological Survey

The United States Geological Survey (USGS) is the primary federal government agency for providing information on earthquakes. earthquake.usgs.gov

- The USGS National Seismic Hazards Map is a national standard for identifying earthquake hazard zones. https://www.usgs.gov/natural-hazards/earthquake-hazards
- USGS also maintains a site dedicated to Colorado Earthquake Information. https://earthquake.usgs.gov/earthquakes/byregion/colorado.php

National Earthquake Hazards Reduction Program

The National Earthquake Hazards Reduction Program (NEHRP) is the federal government's coordinated long-term nationwide program to reduce risks to life and property in the U.S. resulting from earthquakes. nehrp.gov/index.htm

Federal Emergency Management Agency (FEMA)

FEMA maintains a resource website that provides useful information regarding earthquakes. fema.gov/earthquake

Additionally, Hazus is available from FEMA for estimating vulnerability due to earthquakes. Hazus is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes. Hazus uses Geographic Information Systems (GIS) technology to estimate physical, economic, and social impacts of disasters. It graphically illustrates the limits of identified high-risk locations due to earthquakes, hurricanes, and floods. Users can then visualize the spatial relationships between populations and other more permanently fixed geographic assets or resources for the specific hazard being modeled, a crucial function in the pre-disaster planning process. fema.gov/hazus

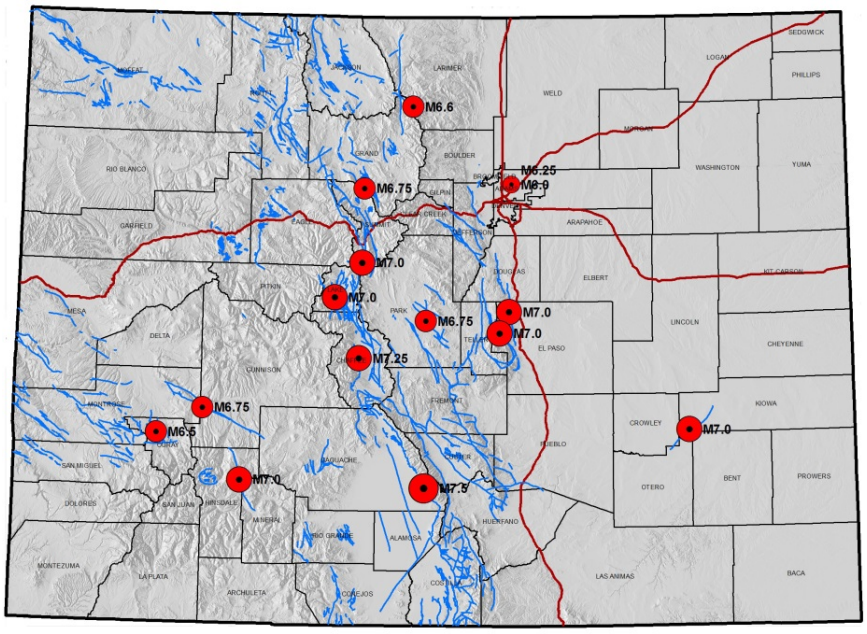
The Colorado Geological Survey utilized Hazus to determine the potential locations and impacts of various magnitude earthquakes on faults across Colorado. Hazus summary reports on potential losses may be downloaded for both statewide scenarios as well as for individual counties at: http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/risks-hazards-loss/potential-losses-hazus/

Colorado Earthquake Hazard Mitigation Council

The Colorado Earthquake Hazard Mitigation Council (CEHMC) is a multi-disciplinary organization that is interested in developing a better understanding of earthquake hazards in Colorado. The group meets monthly and has been in existence in various forms for more than three decades. http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/colorado-earthquake-hazard-mitigation-council-cehmc/

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.



The CGS Interactive Hazus Events Map details epicenters of possible future seismic events based on Maximum Credible Earthquakes (MCE) that have been assigned to specific faults by various entities. Each of the event locations have been analyzed using FEMA Hazus software and correspond to statewide reports on potential loss and damage.

Applicable Planning Tools and Strategies – earthquake	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Hazard mitigation plan • Pre-disaster planning • Resilience Planning
Strengthening Incentives	*N/A*
Protecting Sensitive Areas	• 1041 Regulations
Improving Site Development Standards	• Site-specific Assessment • Subdivision and Site Design Standards
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	• Post-disaster building moratorium

Flood

Description

Flooding is the most frequent and costly natural hazard in the United States—a hazard that causes more fatalities than any other natural hazard and averages nearly $10 billion in losses per year. Nearly 85 percent of federal disaster declarations result from natural events where flooding was a major factor (*Implementing a Federal*, 2015, p. 2).

Technically, a flood is a general and temporary condition of partial or complete inundation of normally dry land areas from: (1) the overflow of stream banks; (2) the unusual and rapid accumulation of runoff of surface waters from any source; or (3) mudflows or the sudden collapse of shoreline land. Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel or accumulates faster than surface absorbency allows (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-47). The severity of a flood event is typically determined by a combination of several factors, including but not limited to precipitation and weather patterns, stream and river basin topography and physiography, stormwater conveyance capacities, recent soil moisture conditions, and the degree of vegetative clearing and/or impervious surface coverage.

Floods in Colorado generally result from the accumulation of water from excessive precipitation and/or rapid snowmelt. They can be classified under two categories: general floods, resulting from heavy precipitation or snowmelt in a given watershed over an extended period of time; and flash floods, the product of heavy localized precipitation in a short time period.

General floods are typically long-term events that may last for multiple days, and over widespread areas. The primary type of general flooding in Colorado is associated with lands adjacent to riverine and lake areas, and is a function of excessive precipitation levels and the inability of natural systems to adequately absorb or convey the resulting volume of runoff. Urban/stormwater flooding occurs where development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

More frequent in Colorado is **flash flooding**, most of which is caused by slow-moving thunderstorms with intense but isolated rainfall. Such events develop rapidly and are intensified by major elevation changes, steep slopes, and base alluvial fans that characterize mountain river canyons. Flash flooding events may also be caused by a sudden failure or release by a dam, levee, retention basin, or other stormwater control facility, or by the obstruction of natural flows by ice jams or other blockages that cause backflow and overtopping. Although flash flooding occurs most often along Colorado's mountain streams, it is also common in urbanized areas where much of the natural landscape is covered by impervious surfaces.

The Big Thompson flood of 1976 was the deadliest flash flood in Colorado's recorded history.

Source: Denver Post. The Archive. July 31, 2012. Photo by Steve Larson. blogs.denverpost.com/library/2012/07/31/big-thompson-flood-disaster-colorado-1976/2795

The periodic flooding of lands adjacent to rivers, streams, lakes, and other water bodies (land commonly known as "floodplain") is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is typically defined as the average projected time (in years) between a particular magnitude flood event or annual percent chance of that flood occurring. For example, the "100-year" flood has a one percent chance of occurring in any given year, and the "500-year" flood has a 0.2 percent chance of occurring in any given year—and these two distinct magnitudes are the basis for the special flood hazard areas identified in FEMA Flood Insurance Rate Maps (FIRMs). The recurrence interval is an *average*; it does not necessarily mean that a flood of such a magnitude will happen exactly every 100 years or 500 years, and in some cases only a few years may pass between major flood events.

It is important to note that flooding is not always confined to special flood hazard areas identified by FEMA. Therefore, even homes that are not in the mapped floodplain should exercise caution and diligence during flood events and should prepare themselves before

flooding occurs. Some jurisdictions regulate based on their own, more stringent floodplain maps.

Flooding in Colorado

Colorado communities are impacted by flooding on an annual basis, and nearly every community in the state is subject to special flood hazard areas as mapped by FEMA and as made available through the Colorado Water Conservation Board. In addition, there are approximately 677 state-regulated dams that, in the event of a failure, could cause loss of life and/or significant property damage in communities located within downstream flood hazard areas.

The September 2013 flood disaster caused major damage to private property and public infrastructure across the Front Range of Colorado.

Source: Federal Emergency Management Agency. Colorado Town Isolated. May 1, 2014. Photo by Steve Sumwalt. fema.gov/media-library/assets/images/72550

The most flash-flood prone regions of Colorado are found along the base of the lower foothills east of the mountains. Several extreme floods such as the infamous Big Thompson Canyon flood of July 31, 1976, have occurred in this vulnerable area. Flash floods occur on the Western Slope as well, but with typically lower frequency and intensity due to a reduced supply of moisture to fuel such storms (*Colorado Climate Center*, 2015).

Flood hazards pose major risks to property and human life and have caused some of the largest disasters in Colorado history in terms of financial costs and casualties. Between 20 to 30 large-magnitude floods occur somewhere in the state every year, and major flood disasters (warranting a federal disaster declaration) have occurred on average every five years since 1959. The South Platte River floods of 1965 and the 2013 floods in the Front Range and northeast counties caused multiple deaths and nearly $3 billion and $4 billion in total estimated damage in current terms, respectively. The Big Thompson River flood of 1976 caused 144 deaths. Floods can cause billions of dollars of property and infrastructure damage, resulting in significant economic impacts for directly affected communities and for the state as a whole (*Colorado Resiliency Framework,* 2015, p. 3-4).

Related Hazards

While floods are most frequently caused by heavy precipitation associated with sustained wet weather and/or severe thunderstorms, they may also be caused or exacerbated by other hazards including ice jams or rapid melting and runoff following severe winter storms. In the 2013 Colorado floods, a major cause of flood damage was debris that clogged up bridges and culverts. Another major issue in 2013 was waterways carving entirely new channels, meaning risk had not been conveyed on existing maps. The state is currently developing a new methodology to identify potential risk associated with channel migration, erosion zones, and alluvial fans.

Flooding is one of the three central components (along with drought and wildfire) of a complex system of interrelated natural hazards that are fundamentally tied to Colorado's continental semi-arid climate. Drought conditions may lead to soil compaction, and wildfires may leave slopes denuded and hydrophobic (unable to absorb water). In these cases a single heavy rain event can lead to higher volumes of runoff and a correspondingly higher risk for flash flooding, erosion, and particularly mud/debris flows (described below in this guide).

In addition to the direct impacts a flood event hazard may cause, it can also trigger multiple cascading hazard events. Rising floodwaters may cause the failure of a dam, levee, or other impoundment structure resulting in the rapid inundation of locations outside of mapped special flood hazard areas. Major flood events may also increase the risks of geologic hazard events (landslide, mud/debris flow, and rockfall), soil hazards, and hazardous material releases.

Assessing the Risk of Flood

Community planners should begin assessing flood risk by coordinating with their local floodplain administrator, along with the appropriate staff at the Colorado Water Conservation Board (CWCB), on the identification of the best currently available data and tools for assessing flood risk, as well as the status of any updates or possible enhancements to those resources.

Communities with GIS resources available to support their planning efforts will be able to conduct more rapid and robust risk assessments, including overlay analysis, to quantify the exposure of people, parcels, buildings, critical facilities, and other community assets that are within Special Flood Hazard Areas (SFHAs). They may also use FEMA's *Hazus* software to help estimate monetary losses based on a variety of scenario flood hazard events (this capability exists even for communities without their own digital flood risk data). However, while Hazus is a helpful loss estimation tool, it is not predictive of future events. Communities that do not have GIS capabilities or resources should consult the range of digital online mapping viewers available, including the Colorado Flood Decision Support System (DSS) or the FEMA Flood Map Service Center. These mapping tools allow for some higher-level spatial analysis and the creation of customizable and printable flood maps (FIRMettes) that can be helpful in assessing flood risk for local planning and regulatory measures. In some cases, however,

communities may have on-the-ground information that is better than modeling, such as, for example, public works records of roads and bridges that consistently have issues in flood events.

Most communities in Colorado rely on their effective floodplain maps (i.e., Flood Insurance Rate Maps issued by FEMA that become effective on a particular date) as the official source of flood risk information for local planning and regulatory measures, which at a minimum includes adopting and enforcing the State's Model Floodplain Damage Prevention Ordinance (Colorado Department of Natural Resources, 2012). All communities in Colorado with mapped flood hazard areas have access to either hard copy/static Flood Insurance Rate Maps (FIRMs) or Digital Flood Insurance Rate Maps (DFIRMs), along with the associated Flood Insurance Study from the FEMA Flood Map Service Center. Communities with GIS capability but without DFIRM datasets may still have access to digital Q3 flood layers, which provide some limited spatial data for GIS analysis and mapping purposes.

The delineation and updating of floodplain maps is generally performed by private engineering firms under contract with FEMA, which administers the nation's flood hazard mapping program in coordination with CWCB. Based on strict guidelines, floodplain maps are created through the use of statistical information such as data for river flows, rainfall and topographic surveys, and hydrologic and hydraulic (H&H) analyses. Hydrologic modeling calculates the peak discharges of water at key locations in a watershed, while hydraulic modeling computes surface water velocities and elevations along with flood profiles and flood boundaries using input from the hydrologic models. More information on the technical aspects of floodplain mapping can be found at fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping.

The primary gaps or weaknesses with these tools may include outdated and/or inaccurate map data. Even new DFIRMs may not reflect all flood hazards (e.g., urban drainage/stormwater flooding, fluvial erosion, etc.) or future conditions (e.g., future floodplains and base flood elevations that take into account projected watershed development, hydrologic changes, etc.). Also, aside from a few new Risk MAP projects, most flood risk databases do not include the non-regulatory information that may be useful for enhanced planning purposes (e.g., flood depth/velocity grids, areas of mitigation interest, and other flood risk assessment data). Another challenge for many communities is the lack of GIS capabilities or resources to help facilitate the spatial analysis and mapping of flood risk to support the implementation of additional planning tools or strategies.

The 2013 floods highlighted the need for better mapping (including floodplains, erosion zones, and debris flows), and in response the Colorado legislature provided funding in early 2015 to update natural hazard maps statewide. This update process is currently underway.

Communities that are interested in adjusting or improving the quality of their floodplain maps, or expanding on the accessible flood risk products associated with development, should coordinate closely with the CWCB. While flood risk studies and hazard mapping are often prohibitively expensive, a range of techniques is available to communities through

higher regulatory standards encouraged under the National Flood Insurance Program (NFIP) and Community Rating System (CRS) that should be considered.

For example, if a community is interested in regulating new development to flood elevations that are expected to increase due to future growth and development, it may consider the use of future-conditions hydrology in the creation of its own regulatory floodplain maps. Such maps can account for future floodplain conditions and may be adopted by communities to enact more stringent development standards, but would not be linked to insurance rates and purchase requirements under the NFIP. In the absence of pursuing the development of future floodplain conditions maps (which is not part of FEMA's flood hazard mapping program and may be costly), communities may consider adopting the 500-year (or 0.2-percent-annual-chance) flood zone as their regulatory floodplain versus the 100-year (or 1-percent-annual-chance flood zone) as currently required under the NFIP.

Available Data Sources

Colorado Risk MAP

The purpose of the Colorado Risk MAP Program is to deliver quality data, technical assistance, and other non-regulatory tools that increase public awareness of flooding potential and lead to action that reduces risk to life and property.
http://www.coloradohazardmapping.com/hazardMapping/floodplainMapping

Colorado Flood Decision Support System (DSS)

The Colorado Flood DSS is an online interactive mapping application that provides useful flood hazard information. http://cwcb.state.co.us/technical-resources/decision-support-systems/Pages/main.aspx?.

The application allows users to:

- Review effective floodplain boundaries
- See real-time weather and streamflow conditions
- Access local and county data related to flooding
- Access data related to historical floods, hazards, weather modification, watershed restoration, and FEMA's National Flood Insurance Program

In addition, the DSS provides links to a wide range of additional resources for flood-related information. http://cwcb.state.co.us/technical-resources/decision-support-systems/Pages/main.aspx?

FEMA Flood Map Service Center

The Flood Map Service Center is the official public source for flood hazard information produced in support of the National Flood Insurance Program. From this site, users can obtain official flood maps, access a range of other flood hazard products including Flood Insurance Studies (FIS), and take advantage of tools to better understand flood risk.
https://msc.fema.gov/portal/home

Colorado Hazus Flood Risk Data

The 2018 *Colorado Natural Hazards Mitigation Plan* includes planning-level flood loss estimates for every county in Colorado, as generated by Hazus, FEMA's loss estimation software. This includes a summary of vulnerability and potential losses by county, as determined though modeling the one percent annual chance (100-year) floodplain and performing associated building and population risk assessments across the state. See pages 3-55 through 3-59 of the plan at dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan

Colorado National Flood Insurance Program (NFIP) information

State NFIP, repetitive loss, and Risk MAP data is available through the Colorado Water Conservation Board or the Division of Homeland Security and Emergency Management. cwcb.state.co.us

NFIP Policy and Claim Statistics by Jurisdiction

These policy and claim statistics provide routinely updated data on the number of policies in-force, amount of coverage, and premiums paid for each participating NFIP community, along with data on the number of insured losses and total payments of past claims. https://www.fema.gov/policy-claim-statistics-flood-insurance

Colorado Dam Safety Information

Upon request, the Colorado Division of Water Resources can provide helpful data and information to local officials on existing dam structures, such as hazard classifications, emergency action plans, and dam failure inundation maps. Access to all such information is subject to DWR's Public Access to Dam Files and Records policy. water.state.co.us/DWRIPub/Documents/policy01-05.pdf

Division of Water Resources, Dam Safety Branch: water.state.co.us/damsafety/dams.asp

Dam inundation maps: bill.mccormick@state.co.us.

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

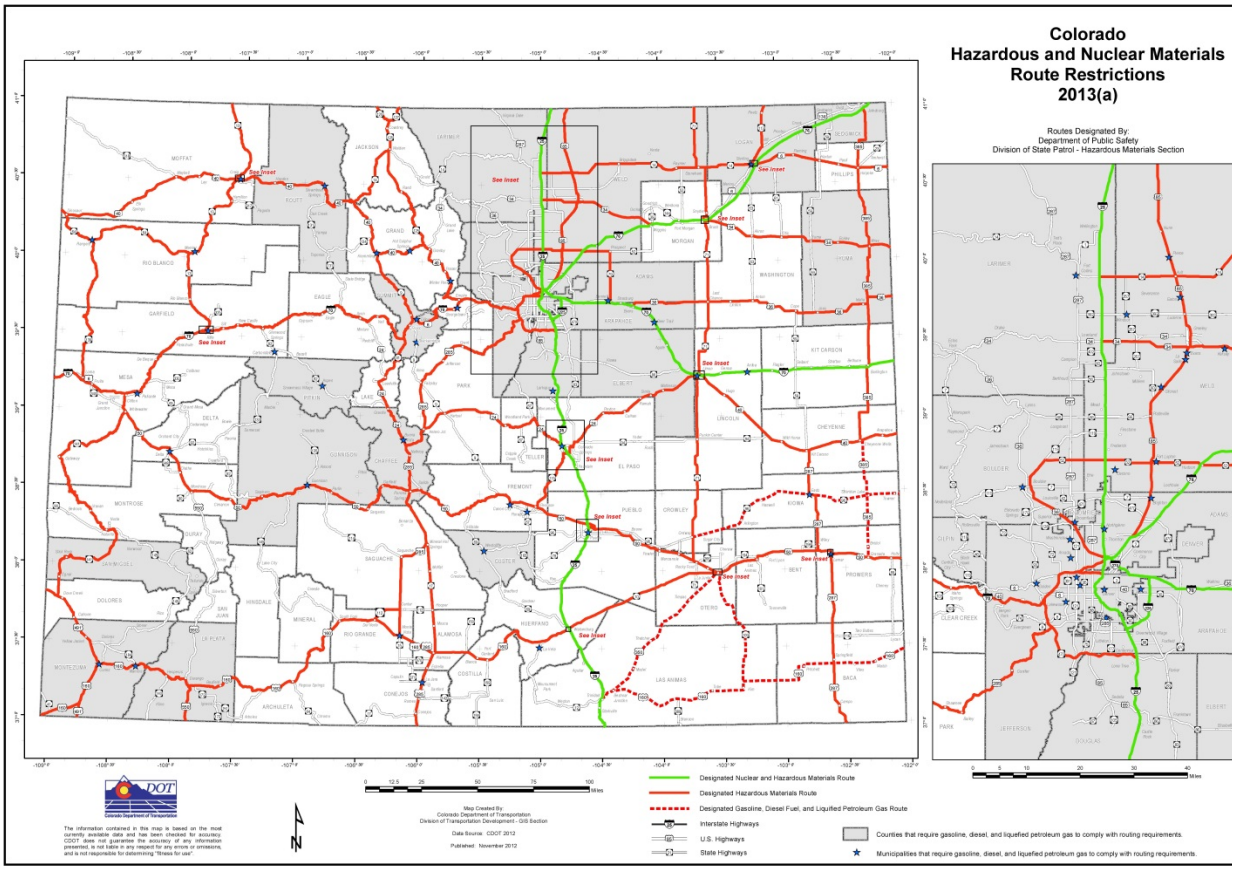
Applicable Planning Tools and Strategies – Flood	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	• Community Rating System • Development agreement • Density bonus • Transfer of development rights

Protecting Sensitive Areas	• 1041 regulations • Cluster subdivision • Conservation easement • Land acquisition • Overlay zoning • Stream buffers and setbacks
Improving Site Development Standards	• Stormwater ordinance • Site-specific assessment • Subdivision and site design standards • Use-specific standards
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	• Application submittal requirements • Post-disaster building moratorium

Hazardous Material Release

Description

A hazardous material (HAZMAT) is any element or compound that, because of handling, storing, processing, or packaging, may have detrimental effects upon the public (especially emergency personnel) and/or the environment (*State Emergency Operations Plan*, 2015, p. Tab A-6 to Tab A-7). Hazardous materials are found in forms and quantities that can potentially cause death, serious injury, long-lasting health effects, and property damage in varying degrees. They may be flammable, corrosive, detonable, toxic, radioactive, oxidizers, disease-causing agents, or highly reactive. They are routinely used and stored in homes and businesses and are also shipped daily on Colorado's highways, railroads, waterways, and pipelines. Hazardous material releases include spilling, disposal, or other form of discharge into the environment.



Colorado's HAZMAT routing map provides information on the major roadways designated for the transport of mobile hazardous materials. The red lines are designated hazardous materials routes, and the green lines are designated nuclear and hazardous materials routes.

Source: Colorado State Patrol. Hazardous Materials Routing Map. 2013. colorado.gov/pacific/sites/default/files/Hazardous Materials Routing Map.pdf

Incidents involving hazardous material releases can apply to fixed facilities as well as mobile, transportation-related accidents. Between 2005 and 2014, approximately 166,000 HAZMAT incidents were reported nationwide. Nearly 86 percent of these were highway incidents, nine percent involved the air industry, and four percent were railroad incidents (*Incident Reports Database Search*, n.d.*)*. These HAZMAT events generally consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, and most by accident versus an intentional act. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a HAZMAT release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife.

Hazardous Material Releases in Colorado

Hazardous materials used in agriculture, industry, and in the home pose a daily hazard to people and the environment. Coloradans are vulnerable to the adverse effects of accidental leakage of hazardous materials or a deliberate act using these materials. According to the State Emergency Operations Plan, statewide there are approximately 5,800 fixed facilities where reportable concentrations of hazardous materials are used and/or stored, and the oil and gas production industry accounts for approximately 4,200 of those facilities. Between 2010 and 2012, the Colorado Department of Public Health and Environment (CDPHE) recorded 2,718 reported spills or releases. More than one-third of those were at fixed facilities, with the remainder associated with mobile HAZMATs. The steady growth in the use of chemicals has resulted in an increased need to transport these materials, and according to DHSEM, hazardous materials are transported over nearly every roadway throughout the state (*State Emergency Operations Plan*, 2015, p. 12). All roads that permit hazardous material transport are considered potentially at risk of an incident.

Hazardous material releases can also occur at fixed sites, such as abandoned mines, where materials are being stored and/or treated on site. The Colorado Division of Reclamation Mining & Safety estimates that there are over 22,000 abandoned mines in the state (Ogburn, 2015).

In August 2015, the EPA accidently released 1 million gallons of toxic water from an abandoned mine near Silverton, Colorado into the Animas River. The spill triggered warnings from health officials to steer clear from the river until officials deemed the river safe (Paul & Finley, 2015).

Related Hazards

Hazardous material releases may be caused by a range of incidents including an industrial or transportation accident, or deliberate criminal act. They can also occur as a result of or in tandem with natural hazard events such as earthquakes and other geologic hazards, floods, windstorms, and winter storms. In addition to causing additional life safety threats, these compound hazard events can also greatly complicate and hinder response efforts and result

in major environmental impacts. The large-scale release of hazardous materials in combination with events such as flooding or windstorms can increase the spread of contamination threat zones to large geographic areas and amplify the potential long-term impacts to human and ecological health.

Assessing the Risk of Hazardous Material Release

Hazardous material releases can be localized events (such as small releases at a fixed site) or regional events (such as nuclear/radiological events). Several variables come into play when determining a community's risk to hazardous material releases. Factors that help determine a community's vulnerability to this hazard include:

- The size of the community (both geographically and physically)
- The location and number of fixed sites containing potential hazardous material(s)
- The community's proximity to mobile HAZMAT (road and rail) risk areas where releases could occur

One of the difficulties of addressing the hazardous material release hazard is that it takes time and effort to identify all of the potential fixed hazardous material sites in a community. There are several federal, state, and local sources to investigate, and each community will have a different level of vulnerability.

When assessing community risk to hazardous materials release, the first step a community will want to take is to conduct a hazard identification process that will include development of a hazard profile that identifies the potential sources of the hazard, how the hazard has impacted the community in the past, how it could impact the community in the future, and the extent to which the hazard could impact the community.

Once a detailed hazard profile has been assembled, a vulnerability assessment can be conducted to determine the exposure of people and other community assets that could potentially be impacted by a hazardous material release. Community planners will have to evaluate which type of vulnerability analyses will work best for their community's needs based on what types of threats are present. For example: Are air plume analyses needed for airborne releases? Is it necessary to determine vulnerabilities to water systems for potential water-borne releases? Or is it necessary to consider other, more serious types of analyses due to potential radioactive or nuclear risks?

Available Data Sources

Environmental Protection Agency (EPA) Toxic Release Inventory Program

Tier II Reports are required by the EPA whenever a hazardous material is released, and are available at the county level from County Emergency Managers and/or the Environmental Protection Agency. epa.gov/toxics-release-inventory-tri-program

U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration

The Pipeline and Hazardous Materials Safety Administration (PHMSA) was established to protect people and the environment from the risks of hazardous materials transportation. The PHMSA website is a good source of hazardous materials incident data and other information relevant for hazardous materials and pipeline safety. https://www.phmsa.dot.gov/about-phmsa/offices/office-hazardous-materials-safety

Colorado Department of Transportation (CDOT)

CDOT's Hazmat Routing Overview page provides current Hazmat routes and information related to designating roadways as Hazmat routes. codot.gov/business/hazmat-routing

EPA's Areal Locations of Hazardous Atmospheres (ALOHA) Program

EPA's ALOHA is a modeling program for the CAMEO (Computer-Aided Management of Emergency Operations) software suite, which is widely used to plan for and respond to chemical spills. ALOHA allows users to enter details about a real or potential chemical release, and will generate threat zone estimates for various types of hazards. The threat zone estimates are shown on a grid in ALOHA, and they can also be plotted on maps in MARPLOT (Mapping Application for Response, Planning, and Local Operational Tasks), Esri's ArcMap, Google Earth, Hazus, and Google Maps.

- ALOHA - epa.gov/cameo/aloha-software
- CAMEO - epa.gov/cameo/what-cameo-software-suite
- MARPLOT - epa.gov/cameo/marplot-software

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

Applicable Planning Tools and Strategies – hazardous material release	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Hazard mitigation plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	• Development agreement
Protecting Sensitive Areas	• 1041 regulations
Improving Site Development Standards	• Subdivision and site design standards • Use-specific standards
Improving Buildings and Infrastructure	• Critical infrastructure protection
Enhancing Administration and Enforcement	• Application submittal requirements • Post-disaster building moratorium

Extreme Heat

Description

Extreme heat is defined as weather that is "substantially hotter and/or more humid than average for a location at that time of year" (*Hazard Identification and Risk*, 2011, p. 31) The Heat Index, which measures the "apparent temperature" when considering both air temperature and humidity, is used by organizations like the National Weather Service to identify extreme heat days. Extreme heat is particularly dangerous when occurring for a prolonged period (known as a "heat wave").

Periods of extreme heat can cause serious injury or death to exposed populations, especially the elderly, infants, transient populations, persons with physical and mental impairments, and those without access to air conditioning or social services. Extreme heat is also associated with increased demands for electricity and water, and can potentially stress local and regional infrastructure and services. Prolonged periods of extreme heat can have negative impacts on farming and livestock, and may lead to algae blooms that increase the risk of fish kills. Extreme heat can also have a negative impact on health and productivity, with a direct impact on economic activity and travel. Warming temperatures and extreme heat have also been shown to have negative impacts on forests, aquatic ecosystems, and wildlife and fish populations (*Rocky Mountain Forests,* 2014).

Extreme Heat in Colorado

Summertime temperatures are lower in the mountains and at higher elevations; therefore, extreme heat hazards in Colorado tend to occur in the Front Range, Grand Valley, Eastern Plains, and extreme southwest (*Colorado Natural Hazards Mitigation Plan*, 2013, p. 3-38). The number of extreme heat days in Colorado has been rising in recent years. In Denver, for instance, seven of the ten hottest years since 1874 occurred from 2000-2012 (*NWS Boulder Denver*, n.d.b). In Fort Collins, the number of days per year over 90 degrees from 2000-2013 was almost double the historic average (*Extreme Heat,* 2014). While the overall mortality rate due to extreme heat events has been declining in Colorado over the past several decades, largely due to the increased availability of air conditioning and preparedness for extreme heat hazards, certain groups remain vulnerable. Past extreme heat events have caused damage to state and local infrastructure, especially roadways and utility networks.

Related Hazards

Extreme heat can help create the conditions for drought and can exacerbate the impacts of drought by putting additional stress on available water supplies. Extreme heat can also lead to increased storm activity, which is linked to both high wind and flash flood hazards. It can also contribute to the spread of wildfires.

Available Data Sources

Colorado Natural Hazards Mitigation Plan

The *Colorado Natural Hazards Mitigation Plan* is a key resource for an overview of extreme heat hazards and summaries of national and state-level data on extreme heat. https://www.colorado.gov/dhsem

National Weather Service

The National Weather Service is a key resource for the forecasting of extreme heat events and for the issuance of advisories and warnings. weather.gov

National Oceanic and Atmospheric Administration (NOAA)

The National Oceanic and Atmospheric Administration's National Climatic Data Center (NCDC) provides data on temperatures and extreme heat for the United States and for Colorado. ncdc.noaa.gov/cdo-web/datasets

FEMA and Ready.Gov

FEMA and Ready.Gov have published useful guides for extreme heat preparation and response. ready.gov/heat

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide. In addition to the tools and strategies cited below, other site development standards such as **site selection, building orientation, and landscaping** can also be important tools for reducing potential risks from extreme heat.

Applicable Planning Tools and Strategies – extreme heat	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	*N/A*
Protecting Sensitive Areas	*N/A*
Improving Site Development Standards	*N/A*
Improving Buildings and Infrastructure	• Critical infrastructure protection
Enhancing Administration and Enforcement	*N/A*

Landslide, Mud/Debris Flow, and Rockfall

Description

Landslides, mud flows, debris flows, and rockfalls are among many geologic and soil hazards that impact Colorado.

Landslides are the downward and outward movement of slopes composed of natural rock, soils, artificial fills, or combinations thereof. Common names for landslide types include slump, rockslide, debris slide, lateral spreading, debris avalanche, earth flow, and soil creep (*Colorado Natural Hazards Mitigation Plan*, 2013). Landslides move by falling, sliding, and flowing along surfaces marked by differences in soil or rock characteristics. A landslide is the result of a decrease in resisting forces that hold the earth mass in place and/or an increase in the driving forces that facilitate its movement. The rates of movement for landslides can be very quick (tens of feet per second) or very slow (fractions of inches per year). Landslides can occur as reactivated old slides or as new slides in areas that have not previously experienced them. Areas of past or active landslides can be recognized by their topographic and physical appearance. Areas susceptible to landslides but not previously active can frequently be identified by the similarity of geologic materials and conditions to areas of known landslide activity (p. 3-267 to 3-270).

A **mud flow** is a mass of water and fine-grained earth materials that flows down a stream, ravine, canyon, arroyo, or gulch. If more than half of the solids in the mass are larger than sand grains—-rocks, stones, boulders—the event is called a **debris flow**. Debris and mud flows are combinations of fast-moving water and great volumes of sediment and debris that surge down a slope with tremendous force. They are similar to flash floods and can occur suddenly without time for adequate warning. When the drainage channel eventually becomes less steep, the liquid mass spreads out and slows down to form a part of a debris fan or a mud flow deposit. In the steep channel itself, erosion is the dominant process as the flow picks up more solid material. Any given drainage area may have several mud flows a year, or none for several years or decades. They are common events in the steep terrain of Colorado and vary widely in size and destructiveness. Extreme amounts of precipitation in a very short period of time (e.g., cloudbursts) and flash floods are the usual sources for creating a mud flow in Colorado (p. 3-268 to 3-270).

2011 landslide along West Mosquito Creek in Park County, Colorado.

Source: Colorado Geological Survey, photo by Division of Reclamation and Mining.
coloradogeologicalsurvey.org/geologic-hazards/landslides-2/colorado-landslide-inventor/

Rockfalls are a newly detached mass of rock falling from a cliff or down a very steep slope. Rockfalls are the fastest type of landslide and occur most frequently in mountains or other steep areas during early spring when there is abundant moisture and repeated freezing and thawing. Ice wedging, root growth, or ground shaking, as well as a loss of support through erosion or chemical weathering may start the fall (p. 3-269 to 3-270).

Landslide, Mud/Debris Flow and Rockfall in Colorado

Land movement related to landslides, mud and debris flows, and rockfalls occurs naturally across Colorado on a continuous basis, and can also be triggered through human activity (primarily related to mining, land development, and other disturbances). These events can occur at any time of the year from almost any location along a slope; however, because they are correlated with elevation change, these hazards largely occur in the mountainous region from the Front Range to the West Slope.

According to *READY Colorado*, it is estimated that there are thousands of landslides in Colorado each year, with varying degrees of frequency and severity. Most of these events do not result in casualties or property damage, though the annual damage in Colorado is estimated to exceed $3 million to buildings alone (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-185). A massive landslide in a relatively unpopulated area of Mesa County near Grand Junction killed three people in 2014, leaving a swath of debris three miles long and ¾ of a mile wide. A deadly rockfall in September 2013 claimed five lives of a vacationing family following heavy rains near a popular hiking location near Buena Vista, Colorado (Shoichet, et al., 2013). Rockfalls are less frequent but remain a constant threat, particularly to Colorado's mountain roadways. All of these geologic hazards may endanger Colorado's built environment and can damage or destroy buildings, roads, and other infrastructure when proper land use or mitigation practices are not considered.

Related Hazards

Flash flooding or ongoing heavy rain can be precursors to landslides, mud/debris flows, and even rockfalls. Additionally, drought conditions may lead to soil compaction, and severe wildfire events may leave slopes denuded and hydrophobic. In these cases, a single heavy rain event can lead to higher volumes of runoff and correspondingly a higher risk for flash flooding, erosion, and especially mud/debris flows. Rockfalls are often caused by erosion of earth around larger rocks that then become loose and fall. Earthquakes can also lead to landslides and rockfalls.

Assessing the Risk of Geologic and Soil Hazards

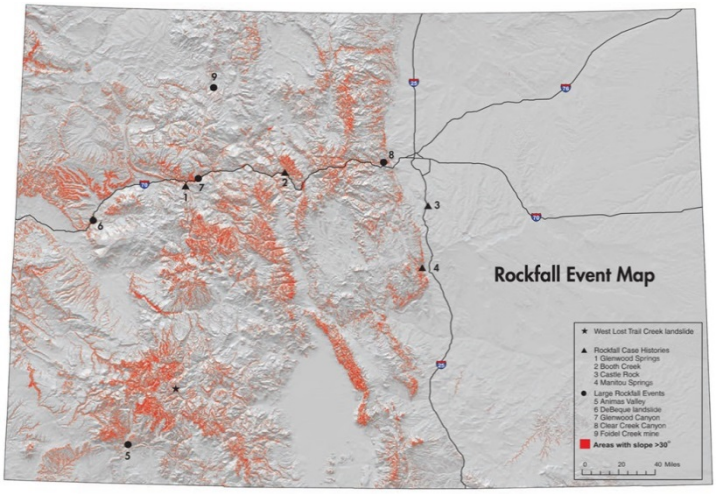
Nearly all geologic and soil hazards are highly localized events. The nature and extent of risk associated with each hazard is specific to local terrain conditions such as slope stability, vegetative cover, and geologic and soil composition beneath the earth's surface. In fact, much of what helps determine the level of hazard risk at a precise location are the features and process that lie underground. Other factors include seasonal, climate, and weather-related phenomena (including other hazards) that can alter the local conditions that affect an

area's current risk. These variables make the identification, assessment, and mapping of geologic and soil hazards more difficult, especially for the purpose of designing and implementing planning tools or strategies. However, given the extreme danger these hazards pose, the knowledge and understanding of a site's geology is essential in order to adequately plan, design, and construct a safe development.

In recognition of this fact, the Colorado Geological Survey (CGS) provides a range of services and resources to assist and advise local planners on geologic hazards, including the review of preliminary plans or reports for new development as well as conducting studies, collecting geologic information, and publishing maps, reports, and bulletins with regard to land use activities.

Still, while a variety of relevant national and statewide data exists to determine hazard risk in a very general sense (including geologic, topographic, and soil maps), most Colorado communities do not have readily accessible information or detailed maps necessary for implementing local regulations. Doing so often requires field surveys and even geotechnical tests by trained earth scientists to identify specific problems associated with land development and public safety.

Consultation with geologists and other experts familiar with local conditions is an important first step for local planners seeking to assess the risk of their community and specific areas that are susceptible to geologic and soil hazards. The CGS and other official sources can provide map information on levels of risk, past hazard events, and the probability of future events. More site-specific data and mapping, however, will need to be obtained through technical studies for specific areas of concern. Communities may opt to hire a consulting geologist or geotechnical engineer to perform this work, or require such expert studies as part of the local development permitting process.



The Colorado Geological Survey's "Rockfall Event Map" identifies locations of historic rockfall events along with steeply sloped areas that are more susceptible to future occurrences.

As summarized in the chapter, *Planning Framework*, there are several state statutes and regulations that specify requirements for the submission of geologic suitability reports in conjunction with land use applications to be reviewed by CGS.[1] Other statutes address the

[1] Senate Bill 35 (1972)-3 requires subdividers to submit reports concerning geologic characteristics and any soil or topographic conditions that present hazards or require special precautions. House Bill 1041 requires that all developments in areas designated by counties as

manner in which geologic and soil hazards are to be addressed by developers and local governments, including but not limited to hazard analyses and site recommendations.

At a minimum, planners should have a general understanding of where geologic and soil hazards exist and what their implications are for safe development so that the viability of available planning tools and strategies to reduce their risk can be further evaluated. Ideally, using this information, most communities should be able to prepare a map of the entire community that distinguishes particular areas of concern. This type of map can help planners and decision makers identify areas that are generally less desirable for future development and may require further technical study, along with smaller-scale maps for implementing regulations or requiring closer examination during the review of development proposals.

Available Data Sources

Geologic hazards such as landslides, mud and debris flows, and rockfalls are sporadic and somewhat unpredictable; however, geologic studies can determine historic runs and existing movement in the earth suggesting movement is occurring or imminent.

Colorado Geological Survey

The Colorado Geological Survey is the primary State agency for providing information and maps on geologic hazards such as landslides, mud/debris flows, and rockfall. Additionally, the Colorado Landslide Hazard Mitigation Plan and the Colorado Landslide Viewer are useful tools addressing these hazards locally. coloradogeologicalsurvey.org

- Landslides - http://coloradogeologicalsurvey.org/geologic-hazards/landslides/
- Mud/debris flow - coloradogeologicalsurvey.org/geologic-hazards/debris-flows-fans-mudslides
- Rockfall - coloradogeologicalsurvey.org/geologic-hazards/rockfall
- Landslide Hazard Mitigation Plan - store.coloradogeologicalsurvey.org/product/colorado-landslide-hazard-mitigation-plan
- Colorado Landslide Viewer - http://coloradogeologicalsurvey.org/geologic-hazards/landslides/colorado-landslide-inventory/
- Through the CGS's ongoing STATEMAP program, new geologic map information is becoming more readily available and more frequently incorporated into local and countywide decision-making. CGS also manages a GIS library of digital geologic data that can be combined with local datasets to better understand the relationship between community assets and areas of potential hazard concern. coloradogeologicalsurvey.org/geologic-mapping/statemap-program

geological hazard areas be engineered and administered in a manner that will minimize significant hazards to public health and safety or to property. House Bill 1045 (1984)-4 requires school districts to submit reports regarding geologic suitability for raw land purchases, new school plans, and improvements to existing schools to the CGS for review.

United States Geological Survey (USGS)

USGS is the primary federal reference for national data regarding these hazards. The USGS Landslides Hazards Program provides several useful resources related to these hazards including the USGS Landslide Overview Map of the Conterminous United States.

- Landslide program - https://www.usgs.gov/natural-hazards/landslide-hazards
- Landslide overview map - https://pubs.er.usgs.gov/publication/ofr97289

Colorado Department of Transportation

The Colorado Department of Transportation, Materials and Geotechnical Branch, manages the state's soils and rockfall program. This agency is responsible for the Rockfall Mitigation Project Plan (RMPP), which includes a list of the 756 rockfall sites identified in Colorado as having chronic rockfall problems. https://www.codot.gov/business/designsupport/matgeo

Applicable Planning Tools and Strategies

In addition to the tools and strategies cited below that are profiled in this guide, **hillside development standards** are also important tools for reducing potential risks from landslides and similar hazards. Hillside standards often include limitations on grading and earth removal and standards for site improvements such as retaining walls.

Applicable Planning Tools and Strategies – Landslide, Mud/Debris Flow, and rockfall	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	• Development agreement • Density bonus • Transfer of development rights
Protecting Sensitive Areas	• 1041 regulations • Cluster subdivision • Conservation easement • Land acquisition • Overlay zoning • Stream buffers and setbacks
Improving Site Development Standards	• Stormwater ordinance • Site-specific assessment • Subdivision and site design standards • Use-specific standards
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	• Application submittal requirements • Post-disaster building moratorium

Soil Hazards: erosion and deposition, expansive soils, and subsidence

Description

Erosion is the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice. **Deposition** is the placing of the eroded material in a new location. All material that is eroded is later deposited in another location (*Colorado Natural Hazards Mitigation Plan*, 2013, p. 3-166). In Colorado, erosion and deposition are typically initiated by water or wind.

- **Riverine erosion** is the long-term process whereby river banks and riverbeds are worn away. This process is best described as a river's tendency for constant course alteration, shape and depth change, and the balancing act between the water's sediment transport capacity and its sediment supply. Swiftly moving floodwaters cause rapid local erosion as the water carries away earth materials. Deposition occurs where flood waters slow down, pool or lose energy in other ways, and materials settle out.
- **Wind erosion** occurs when wind is responsible for land removal, movement, and deposition and most commonly occurs in exposed areas such as fields, tailings, and deserts. Another factor that controls the amount of erosion is the ease with which material can be dislodged and transported. Hard granites erode very slowly while soft silts and sands erode very quickly.

Expansive (or swelling) soils are soils or soft bedrock that increase in volume as they get wet and shrink as they dry out. Expansive soils contain a high percentage of certain kinds of clay particles that are capable of absorbing large quantities of water. Soil volume may expand 10 percent or more as the clay becomes wet, and the powerful force of expansion is capable of exerting damaging pressures on foundations, slabs, or other confining structures. Subsurface Colorado swelling soils tend to remain at constant moisture content in their natural state and are usually relatively dry at the outset of disturbance for construction on them. Exposure to natural or human-caused water sources during or after development results in swelling, and in many instances the soils do not regain their original dryness after construction, but remain moist and expanded due to the changed environment.

Ground **subsidence** is the sinking of land over man-made or natural underground voids, which can result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. In Colorado, the type of subsidence of greatest concern is the settling of the ground over abandoned mine workings. Collapsing and settling soils are relatively low-density materials that shrink in volume when they become wet and/or are subjected to great weight such as from a building or road. Human activities that lead to subsidence include underground mining, pumping groundwater or petroleum, hydrocompaction, and draining organic soils. Natural causes of subsidence include the

development of sinkholes, rock sliding downward along faults, natural sediment compaction, and melting of permafrost. Subsidence may occur virtually instantly or gradually over many years. It may occur uniformly over a wide area or as local depressions or pits separated by areas that have not visibly subsided. In Colorado, it is most common in the sedimentary rocks over abandoned coal and clay mines. Although less common, subsidence can also occur where underground water has dissolved subsurface materials or has been withdrawn by wells.

Subsidence is a particular concern for many communities across Colorado. This image from 2005 shows road damage likely initiated by subsidence in Golden near the Colorado School of Mines.

Source: Colorado Geological Survey. Case Histories. coloradogeologicalsurvey.org/geologic-hazards/subsidence-mine/case-histories

Soil Hazards in Colorado

Erosion and deposition are occurring continually at varying rates all over Colorado. Point sources of erosion are common to construction sites or other areas where human interaction with the earth results in exposed soil or removal of vegetation, and natural waterways perpetually remove and carry soil from the earth to locations downstream.

Expansive soils are one of the most significant, widespread, costly, and least publicized geologic hazards in Colorado.

About 50 percent of Colorado's soil has a high or very high potential for shrinking and swelling. This, coupled with the fact that most of the homes, schools, public and commercial buildings, and roads in the state are located in areas of potentially swelling clay, means that expansive soils are one of the most significant, widespread, costly, and least publicized geologic hazards in Colorado.

Subsidence and collapsible soils tend to be problematic along the Front Range, Western Slope, and in the central mountains near Eagle County. Occurrences of subsiding and collapsing soils date back to Colorado's early history throughout these locations.

Related Hazards

Many other hazards and naturally occurring events are related to erosion and deposition. The natural flow of rivers and streams causes minor erosion and deposition, but flood events create accelerated and more dramatic erosion and deposition rates. For example, the deposition of material can block culverts or impede other engineered and natural conveyances which further aggravate flood conditions. Channel migration resulting from flooding can introduce hazard risk into new areas. Similarly, windstorm events rapidly increase the erosion and deposition of soft silts and sands in exposed areas. Landslides, mud/debris flows, and rockfalls may exacerbate the problems associated with erosion and deposition by making more material available and potentially increasing the rates of each process. Erosion and deposition issues are also exacerbated in wildfire burn areas.

Expansive soils and subsidence are generally influenced by how wet or dry those types of soils become, so the climate of an area, and more specifically the seasonal precipitation/drought cycle associated with arid or semi-arid regions such as Colorado, heavily influences the occurrence and severity of these hazards.

Available Data Sources

Colorado Geological Survey

The Colorado Geological Survey is the primary source of soil hazard data specific to Colorado communities. coloradogeologicalsurvey.org. Hazard-specific pages exist for the following hazards:

- Erosion (includes deposition) - coloradogeologicalsurvey.org/geologic-hazards/erosion

- Collapsible Soils (includes online viewer) - http://coloradogeologicalsurvey.org/geologic-hazards/collapsible-soils/
- Subsidence (Mines) - coloradogeologicalsurvey.org/geologic-hazards/subsidence-mine
- Subsidence (Natural) - coloradogeologicalsurvey.org/geologic-hazards/subsidence-natural
- Swelling Soils - coloradogeologicalsurvey.org/geologic-hazards/swelling-soils

Natural Resources Conservation Service Colorado

The Natural Resources Conservation Service (NRCS) Colorado maintains soil surveys for Colorado. The NRCS also employs a State Conservationist that is a good contact for information about soils hazards. nrcs.usda.gov/wps/portal/nrcs/site/co/home

- Soil Surveys - nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=CO
- State Conservationist - nrcs.usda.gov/wps/portal/nrcs/main/co/contact/state

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

Applicable Planning Tools and Strategies – Soil hazards	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	• Development agreement • Density bonus • Transfer of development rights
Protecting Sensitive Areas	• 1041 regulations • Cluster subdivision • Conservation easement • Land acquisition • Overlay zoning
Improving Site Development Standards	• Stormwater ordinance • Site-specific assessment • Subdivision and site design standards • Use-specific standards
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Wildfire

Description

A **wildfire** is an unplanned, unwanted wildland fire. Wildfires include unauthorized human-caused fires, escaped wildland fire use events (where appropriate management response to naturally-ignited wildland fires escape), escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out (Botts, et al., 2015). While this section's emphasis is on wildfires as an unwanted hazard, it also discusses wildfire in the context of how and why wildland fires occur.

A **wildland fire** is any non-structure fire that occurs in areas of vegetation or natural fuels, and can be either prescribed fire or wildfire. Wildland fire occurs when vegetation, or "fuel," such as grass, leaf litter, trees, or shrubs, is exposed to an ignition source and the conditions for combustion are met, resulting in fire growth and spread through adjacent combustible material. Wildland fires are either ignited by lightning or by some consequence of human activity. In Colorado, lightning accounts for only 17 percent of wildfires, with human ignitions accounting for the remainder (*Colorado Natural Hazards Mitigation Plan,* 2013). Human causes vary and can include escaped debris pile burning, campfires, fireworks, construction sparks, downed transmission lines, and arson.

Wildland fires can occur during any time of year. Although there are frequent references to a "fire season," ignitions are a result of the ability of fuels to support combustion. In addition to an ignition source, the fuel type, amount of fuel, distribution pattern, and moisture content—coupled with weather and topography—will determine the conditions for combustion and resulting fire behavior. Fire behavior characteristics, often referred to as "outputs," include intensity, residence time (i.e., the time required for the active flame zone to pass a stationary point at the surface of the fuel), rate of spread, ember production, ember transport distance, and fire size. These fire behavior outputs determine the influence the wildfire has on adjacent and surrounding fuels through radiant, convective, and conductive heat.

Wildland fire is a natural ecological disturbance process, and in many cases it is necessary ecosystem health. Historically, "natural" fire varied in size, intensity, and severity, creating a mosaic of native vegetation communities across different landscapes. Multiple fire events will occur over time and the frequency and length of the fire return interval is dependent upon the vegetation type and climatic conditions. This natural variation of fire has declined in North America over the past two centuries due to a number of human influences. These influences have significantly altered the natural fire regime and created extensive areas of homogeneous forests (forests of the same composition including trees of the same age, size, species etc.), causing a significant and widespread change in fire effects and fire's influence on ecosystems and people.

Wildfires become wildland-urban interface fires when they transition from natural areas of vegetation to a combination of vegetation and the built environment, such as the Waldo Canyon Fire in 2012.

Fire Adapted Communities, Waldo Canyon Fire 2012, National Interagency Fire Center Photo Gallery. Kari Greer/US Forest Service

The introduction and increasing growth of development adjacent to and intermixed within the natural vegetation across the landscape poses additional risk to people and property. In the context of wildfire, the combustible components of buildings, infrastructure, and associated accessories make them susceptible to ignition and are also considered fuel for the fire. A fire burning in this situation has transitioned from a wildfire to a **wildland-urban interface (WUI) fire**, where a combination of vegetation and man-made structures provide fuel for the fire. This situation increases the complexity, cost, and risk of wildfire in Colorado. In most WUI fire situations, fire suppression resources are quickly overwhelmed and multiple structures are lost.

The terms wildfire hazard and wildfire risk are distinctly

Wildfires and Human Behavior

Wildfires are distinct from other natural hazards in two ways: 1) wildfire activity is not limited to natural environmental causes (such as earthquakes, tornados, or hurricanes) because ignition can also result from human activity; 2) humans have the ability to significantly reduce wildfire threat by altering, redirecting, or (in some cases) extinguishing a wildfire.

Sources: Kari Greer/ NIFC (creative commons license); Castle Rock Fire, Ketchum, ID 2007; National Interagency Fire Center Photo Gallery

different. **Wildfire hazard** refers to the fuels in a given location and represents the intensity with which an area is likely to burn if a fire does occur there. **Wildfire risk** is the probability and consequence of a wildfire burning in an area (based on the wildfire hazard, potential losses, and weather conditions). Identifying wildfire hazard is an important first step in assessing the risk of wildfires. Wildfire risk assessments can be analyzed on different spatial scales, depending on the intended use of the assessment.

Wildfires and Human Behavior

Wildfires are distinct from other natural hazards in two ways:

1. Wildfire activity is not limited to natural environmental causes (such as earthquakes, tornados, or hurricanes) because ignition can also result from human activity;
2. Humans have the ability to significantly reduce wildfire threat by altering, redirecting, or (in some cases) extinguishing a wildfire.

Wildfires in Colorado

Between 2010 and 2014, an average of 1,192 wildland fires, excluding prescribed fires, occurred annually in Colorado. The number of acres can vary greatly; for example, in 2014, a reported 24,949 acres burned throughout the state, while in 2012 a total of 246,445 acres burned due to wildland fires. Annual structural losses across the state also fluctuate. Between 2012 and 2013, more than 1,200 structures were damaged or destroyed by wildfires that swept across the state, resulting in nearly $1 billion in property damage (Badger, 2015). Other years, however, have reported significantly fewer structural losses and damage.

Wildfire size (reported as acres burned) is not always indicative of its impact. The Royal Gorge Fire that began on June 11, 2013 outside of Cañon City, burned a total area of 3,218 acres and destroyed 90 percent of the Royal Gorge Bridge and Park. The Royal Gorge Bridge itself was relatively unaffected, but 48 of 52 buildings—including the visitor center, Aerial Tram, Incline Railway, and other attractions—were destroyed (*Royal Gorge Bridge,* 2014). Examples like this illustrate the long-lasting impacts that wildfires can have on the local economy and the variety of community values at risk.

A 2015 report shows that Colorado has nearly 100,000 homes that are either at high or very high risk of wildfire – translating into $28 billion of residential assets exposed to potential future wildfire damage.

CoreLogic, a national provider of financial and property information, estimates that Colorado ranks as one of the leading states across the western United States in terms of residential properties potentially at risk of future wildfire damage. A 2015 report shows that Colorado has nearly 100,000 homes that are either at high or very high risk of wildfire – translating into $28 billion of residential assets exposed to potential future wildfire damage (Botts, et al., 2015).These trends also reflect a larger pattern associated with increased development in wildfire-prone areas in the West. Community wildfire risk will continue unless more action is taken to reduce and/or mitigate the threat.

Related Hazards

Other hazards can contribute to the potential for wildfires or can influence wildfire behavior:

- High winds can down power lines (providing an ignition source), and/or result in areas of downed and dead trees (increasing fuel loads); high winds can also produce rapid rates of spread on active fires and increase the distance of ember transport beyond the active fire perimeter.
- Floods, landslides, and avalanches can result in areas of heavy fuel loading.
- Earthquakes can crack gas lines, creating a higher potential for ignition.
- Lightning can ignite fuels, resulting in wildland fires.
- Drought conditions increase wildfire potential by decreasing fuel moisture. Warm winters, hot and dry summers, severe drought, insect and disease infestations, years of fire suppression, and growth in the wildland-urban interface continue to increase wildfire risk and the potential for catastrophic wildfire in Colorado (*Colorado Natural Hazards Mitigation Plan*, 2013, p. 3-214).

Wildfires can also contribute to and influence the magnitude of other hazards. Severe wildfire events may leave slopes denuded and hydrophobic. In these cases a single heavy rain event can lead to higher volumes of runoff and correspondingly a higher risk for flash flooding, erosion and deposition, and mud/debris flows.

Wildfire events may also create open slopes through the consumption of mature timber. In some locations where this occurs, this can create new avalanche slide paths, or enlarge existing avalanche slide paths. Finally, major wildfire events may also cause increased risks for geologic hazard events (landslide, mud/debris flow, and rockfall), soil hazards, and hazardous material releases.

Assessing the Risk of Wildfire

Generally, wildfire risk is assessed through combining the following:

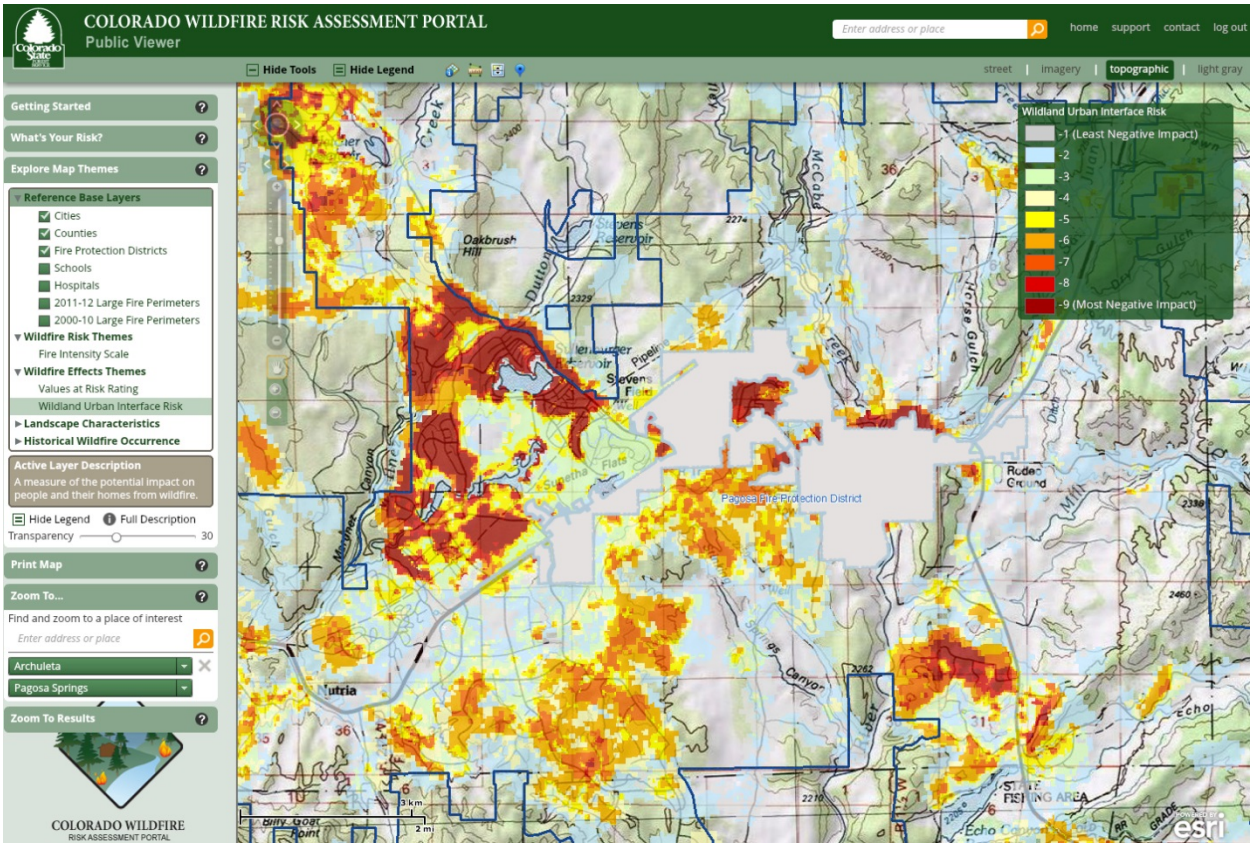
- Ignition probability
- Fire behavior potential
- Vulnerability of the values at risk to direct fire impingement (convective and radiant heat from the fire front) and indirect ignition (airborne embers transported ahead of the fire perimeter)

Assessment inputs include the appropriate fuel, weather, topography, and values at risk for a given area, as discussed in more detail below.

Assessing wildfire hazard and wildfire risk, including the risk of WUI fires, requires specialized expert knowledge in fire behavior, forest ecology and dynamics, and structure and infrastructure ignition vulnerability. However, land use planners and other non-specialists should work closely with experts to provide input and understand the implications of the risk assessment on local land uses.

Some communities have a dedicated wildfire mitigation specialist on staff that can provide this level of expertise. Other communities may have access to specialized expertise through the local fire authority, district forest service, academic partners, or other local organizations (e.g., nonprofit or research organizations). It is also common for communities to hire external consultants that specialize in this area.

There are a number of wildfire hazard and risk assessment tools available to communities. For those communities with limited capacity or resources, the most accessible tool developed specifically for Colorado is the Colorado Wildfire Risk Assessment Portal



The Colorado Wildfire Risk Assessment Portal (CO-WRAP) supports communities in assessing their wildfire risk by providing a helpful starting point in viewing and analyzing areas at risk.

Source: Colorado Wildfire. 2016. coloradowidlfirerisk.com

(COWRAP).

In addition, there are many widely available guides to help communities develop Community Wildfire Protection Plans, such as *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland–Urban Interface Communities* (2004) (frequently referred to as the CWPP Handbook). These (and similar publications) provide communities with concise, step-by-step approaches for developing a Community Wildfire Protection Plan (CWPP), including a hazard and risk assessment. Summit County is an example of a community that followed the CWPP Handbook guidance for the hazard and risk assessment process in the development of

their CWPP. For more information on CWPPs, refer to the tool profile in the main body of the guide.

Finally, some communities elect to work with a consultant that provides a risk assessment based on their own unique proprietary tool. Eagle County, for example, used a proprietary tool that classifies the jurisdiction into "firesheds;" and Glenwood Springs approached their hazard assessment through the use of a proprietary tool that identifies wildfire hazard by evaluating a number of structure loss factors, from immediate hazards near an individual property to proximity area hazards, and then combines these with historical fire occurrence.

Many of these tools are based on models or processes that have difference assumptions, limitations, uses, and scales of use. For example, COWRAP will provide a description of the fire intensity potential based on the conditions within the general vicinity of the location defined by the user. Basic recommendations are also provided for preparedness.

All of the wildfire assessment tools face limitations regarding the accuracy of the inputs. For example, many of the tools rely on a combination of vegetation cover inventory, weather, structure, subdivision, and infrastructure/critical spatial data input. Wildland vegetation, weather and community growth, and layout can be extremely dynamic and in a constant state of change. In many cases, there can be significant challenges in keeping the data inputs that feed these tools updated in order to keep the resulting wildfire hazard and risk assessments accurate. In some cases, this lag can be measured in years. Typically, the more complex the assessment, the more difficult it is to keep up to date; however, if kept updated, the complex assessments become a very powerful tool. Finally, all of the current models are based on past and present conditions, and typically do not predict the future. For the same reasons that make keeping the assessments current a difficult task, using these tools to predict future conditions with any degree of accuracy is extremely challenging. It is important that the user of these tools have the knowledge and expertise to thoroughly understand the inputs, outputs, limitations, and assumptions of all of these tools to ensure they are used accurately and in the most effective manner.

When seeking the professional assistance and advice of a wildfire hazard and risk assessment expert, the planner should look for an individual or team that has advanced knowledge and experience in:

- Wildland fire behavior
- The application of structure ignition concepts
- Wildland fuel model identification and classification

Non-Specialists and the Hazard Identification and Risk Assessment

Wildfire hazard identification and wildfire risk assessments require specialized expert knowledge. Non-specialists, however, play an important role in the process. For example, community planners provide necessary information to help identify community values at risk, planned areas of future growth, key demographic trends, emergency response access and evacuation routes, and other features.

As another example, a public works director can provide information on critical infrastructure and planned capital improvements. By participating in the risk assessment process, non-specialists from other departments and/or agencies contribute knowledge and can better understand how wildfire may potentially affect future community risk.

- The assessment of forest and rangeland dynamics and health influence on fire behavior
- Field and model-based wildfire hazard and risk assessment
- The assumptions and limitations of available wildfire assessment tools
- The use and application of spatial applications for wildfire hazard and risk assessment

Available Data Sources

Colorado communities have access to several sources of wildfire hazard data that are useful for identifying wildfire hazard areas and determining community vulnerability to the hazard.

Colorado State Forest Service (CSFS)

The CSFS is the lead state agency for providing information on wildfire risk and mitigation. The Colorado Wildfire Risk Assessment Portal (COWRAP) is the primary mechanism for CSFS to deploy risk information and create awareness about wildfire issues across the state. A public and professional viewer is available online for free (note: anyone can sign up for the professional viewer, which provides additional detail to aid community wildfire planning). coloradowildfirerisk.com. CSFS also promotes multiple programs to help reduce wildfire threat, and provides technical assistance to counties, communities, and residents. csfs.colostate.edu/wildfire-mitigation.

Rocky Mountain Insurance Information Association (RMIIA)

RMIIA is a non-profit insurance communications organization representing property and casualty insurers in Colorado, New Mexico, Utah, and Wyoming. RMIIA compiles overall estimates of insured losses and number of claims filed for catastrophes (insured natural disasters that cause more than $25 million in damages).
rmiia.org/catastrophes_and_statistics/Wildfire.asp

LANDFIRE data

LANDFIRE, Landscape Fire and Resource Management Planning Tools, is a shared program between the wildland fire management programs of the USDA Forest Service and the US Department of the Interior. The website provides free landscape-scale maps and data describing fire recurrence intervals, vegetation, wildland fuel, and fire regimes across the United States. For the advanced wildfire practitioner, LANDFIRE offers fuel model, disturbance, vegetation cover, topography and fire regime data that can be used in conjunction with other inputs (weather, local data) and processed using tools such as ArcFuels, BehavePlus and FlamMap to determine the wildland fire behavior potential and ultimately the wildfire hazard. landfire.gov

Fire-Adapted Communities

A “fire-adapted community” incorporates people, buildings, businesses, infrastructure, cultural resources, and natural areas to prepare for the effects of wildfire. Fire-adapted communities also incorporate other programs and tools, such as Community Wildfire

Protection Plans (which are covered in this guide), Firewise Communities/USA®, the Fire-Adapted Community Learning Network, and Ready, Set, Go! fireadapted.org

National Interagency Fire Center (NIFC)

The NIFC is the nation's support center for wildland firefighting. Eight different agencies and organizations are part of NIFC. Established in 1965 in Boise, Idaho, the center was created as a joint effort by the US Forest Service, Bureau of Land Management (BLM), and National Weather Service, among others, to work together to reduce the duplication of services, cut costs, and coordinate national fire planning and operations. nifc.gov

Colorado Division of Fire Prevention and Control

The agency's mission is to provide leadership and support to Colorado communities in reducing threats to lives, property, and the environment from fire through fire prevention and code enforcement; wildfire preparedness, response, and management; and the training and certification of firefighters. https://www.colorado.gov/dfpc

National Fire Incident Reporting System (NFIRS)

The system provides information on the type and frequency of wildfires that have occurred, including number of wildfires, structure fires, and even other hazard events such as floods, hazardous material spills, etc. Local communities can use the information to help determine risk. nfirs.fema.gov

Applicable Planning Tools and Strategies

In addition to the tools and strategies cited below that are included in this guide, **landscaping requirements** are also important tools for reducing potential risks from wildfire. Landscaping standards often address issues such as plant material selection (e.g., requiring low-water, native vegetation) and the location of new plant materials installed as part of new development.

Applicable Planning Tools and Strategies – Wildfire	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Community Wildfire Protection Plan (CWPP) • Hazard mitigation plan • Parks and open space plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	• Development agreement • Density bonus • Transfer of development rights
Protecting Sensitive Areas	• 1041 regulations • Cluster subdivision • Conservation easement • Land acquisition • Overlay zoning
Improving Site Development Standards	• Site-specific assessment

	• Subdivision and site design standards • Use-specific standards
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection • Wildland-urban interface (WUI) code
Enhancing Administration and Enforcement	• Application submittal requirements • Post-disaster building moratorium

Wind Hazards

Description

Wind hazards in Colorado take three forms: high wind, tornadoes, and severe thunderstorms. It is not unusual to see tornadoes spin out of major thunderstorms or see severe wind accompany thunderstorms.

High winds are wind events with sustained wind speeds of 40 mph or greater and lasting for one hour or longer, or winds of 58 mph or greater for any duration (*National Weather Service,* 2009). Common in Colorado, Chinook winds are warm dry winds that descend from the eastern slopes of the Rocky Mountains, causing a rapid rise in temperature. Sometimes these winds move with considerable force. Cold, dry Bora winds are also experienced in Colorado. These winds are experienced after cold fronts pass through the state from the northwest. Bora winds can reach speeds of over 100 mph (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-88).

A **tornado** is a localized, violently destructive windstorm occurring over land. Tornadoes are generated by severe thunderstorms. Tornadoes in Colorado are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind know as funnel clouds (*National Weather Service,* 2009).

A **thunderstorm** is characterized by the presence of lightning and its resulting thunder. Thunderstorms are usually accompanied by strong winds, heavy rain, and hail, or sometimes no precipitation at all. Thunderstorms may line up in a series of rain bands known as a squall line. A **severe thunderstorm** is a storm that produces a tornado, winds of at least 58 mph (50 knots), and/or hail at least one inch in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. Strong or severe thunderstorms that rotate are known as super cells (*National Weather Service,* 2009).

Wind Hazards in Colorado

High wind events in Colorado are most common along the Front Range (due to Chinook and Bora winds coming down from the mountains) and in the northeastern counties. Additionally, the Grand Valley in the western part of the state has also experienced a high number of wind events.

In Colorado, the primary threat of tornado is east of the Continental Divide along the Front Range and foothills. Three counties (Adams, Weld, and Washington) each had over 100 reported tornadoes between 1950 and 2010. Most of these tornadoes are small and short lived. However, occasional strong tornadoes have been reported. The number of tornado fatalities remains very low for Colorado, but much of this is due to the low population density of some of the most tornado-prone areas of eastern Colorado (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-108).

The average number of thunderstorms exceeding 50 knots from 2010 to 2015 was just over 100 storms per year *(Storm Events Database, n.d.)*. Thunderstorms are quite prevalent in the Eastern Plains and along the eastern slopes of the mountains during the spring and summer.

Related Hazards

Severe thunderstorms can spawn super cells that can have tornadoes or hail embedded in them. The frequency of hail damage to crops in northeastern Colorado is quite high. With an average frequency of six or more hail days per year, some counties in eastern Colorado are among the most hail-prone areas in the country *(Storm Events Database, n.d.)*. Another related hazard is flash flooding. The greatest threat of flooding in Colorado is not snowmelt; rather, it is flash flooding from localized intense thunderstorms.

Assessing the Risk of Wind Hazards

Unlike some of the other hazards that have loss estimation tools such as Hazus, there are no widely used tools available for predicting or assessing risks or potential losses to wind hazards. To assess wind hazards, communities may need to rely on historical wind hazards as documented in local or regional hazard mitigation plans, or as made available through data resources mentioned below in the available data sources section.

Some key questions for planners to consider in assessing their community's risk to wind hazards may include:

- Is there a history of damaging or destructive wind events in the community? If so, what has been done to minimize future damages to particular assets or sectors?
- Does the hazard event occur more frequently now than previously?
- Do local building codes or regulations adequately address wind hazards?
- Are current warning systems, shelter plans, and emergency procedures in place to protect people from tornadoes?
- Should there be any additional regulatory or incentive-based measures to increase the safety and protection of the community to wind hazards?

Whether to hire a consultant or conduct a community self-assessment is best determined by considering answers to these questions, in addition to consulting with the resources and other local experts as described below in the available data sources section. Planners should also collaborate with the local emergency manager, building inspector, and/or engineer for information regarding wind hazards and associated risks, as well as risk mitigation measures already in place or recommended for future consideration and implementation.

Available Data Sources

Colorado Natural Hazards Mitigation Plan

The *Colorado Natural Hazards Mitigation Plan* is the State's FEMA-approved plan that serves as a foundation for the State's program to reduce risks to people, property, and infrastructure from natural hazards. The Plan is administered and updated by the Colorado Division of Homeland Security and Emergency Management. dhsem.state.co.us/emergency-

management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan

Colorado Climate Center

The Colorado Climate Center is housed in the Department of Atmospheric Science at Colorado State University. It is a source of useful information on natural hazards in Colorado and provides an excellent resource to learn about climate in Colorado. http://climate.colostate.edu/

National Centers for Environmental Information

The National Centers for Environmental Information (NCEI) was formed in 2015 as a merger of NOAA's three existing National Data Centers. This site is a rich data source for climate and historical weather information and contains historical event data on a host of natural hazards. ncdc.noaa.gov/stormevents

SHELDUS™

Developed by the Hazards & Vulnerability and Research Institute at the University of South Carolina, SHELDUS™ provides a county-level hazard loss data and map set for 18 different natural hazard events types, including wind hazards, and has been used by some Colorado communities in completing the risk assessments for their local or regional hazard mitigation plans. https://cemhs.asu.edu/sheldus/

American Society of Civil Engineers

A widely-recognized resource worth consulting for wind hazards is the American Society of Civil Engineers (ASCE), and particularly the data and information made available through *Minimum Design Loads for Buildings and Other Structures (*ASCE/SEI 7-10). This technical publication represents a national standard for requirements on general structural design and it contains ultimate event wind maps for determining wind loads which are suitable for inclusion in building codes and other documents. In addition, this publication includes a detailed commentary with explanatory and supplementary information designed to assist building code staff and regulatory authorities. asce.org

Rocky Mountain Insurance Information Association

RMIIA is a non-profit insurance communications organization representing property and casualty insurers in Colorado, New Mexico, Utah, and Wyoming. RMIIA compiles overall estimates of insured losses and number of claims filed for catastrophes (insured natural disasters that cause more than $25 million in damages).

- Hail: rmiia.org/catastrophes_and_statistics/hail.asp
- Tornadoes: rmiia.org/catastrophes_and_statistics/tornado.asp

National Weather Service (NWS)

The NWS is the official provider of U.S. weather, marine, fire, and aviation forecasts. The NWS issues warnings and provides data, products, forecasts, and information related to meteorology. The NWS is a component of the National Oceanic and Atmospheric

Administration (NOAA). The NWS maintains a glossary of information on more than 2,000 terms, phrases, and abbreviations used by the NWS. https://w1.weather.gov/glossary/

Applicable Planning Tools and Strategies

The table below cites applicable planning tools and strategies that are profiled in this guide.

Applicable Planning Tools and Strategies – wind hazards	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	*N/A*
Protecting Sensitive Areas	*N/A*
Improving Site Development Standards	*N/A*
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	*N/A*

Severe Winter Storm

Description

A **severe winter storm** is defined as a prolonged event involving snow or ice. The characteristics of severe winter storms are determined by the amount and extent of snow or ice, air temperature, wind, and event duration (*National Weather Service*, 2009).

- **Heavy snow** is snowfall accumulating to four inches or more in depth in 12 hours or less, or snowfall accumulating to six inches or more in depth in 24 hours or less. A snow squall is an intense, but limited-duration period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds, and possibly lightning.
- **Blizzards** are characterized by low temperatures, wind gusts of 35 mph or more, and falling and/or blowing snow that reduces visibility to ¼-mile or less for three or more hours.
- **Sleet** is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground. Both types of precipitation, even in small accumulations, can cause significant hazards to a community.
- **Ice storms** are occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines, resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous.

Severe Winter Weather in Colorado

All areas of Colorado are vulnerable to the adverse impacts of Colorado's severe winter weather. Average snowfall is 72 inches or greater in the central (including the Front Range foothills) and western areas of the state (*Colorado Natural Hazards Mitigation Plan,* 2013, p. 3-120). While Colorado blizzards are less frequent and drop less snow in areas further east and north, they can still be devastating. As recently as 1997, several fatalities in northeastern Colorado were directly attributable to an October blizzard that caught many travelers unprepared. Heavy snows in the high mountains are common (p. 3-120).

Related Hazards

Heavy snowstorms in the high mountains are common and can lead to avalanches. Each year several lives are lost due to avalanches. Avalanches pose a serious problem to residents, road maintenance crews, and backcountry travelers.

Colorado's spring flood potential results from melting snow pack at higher elevations. In a year of near-normal snow accumulation in the mountains and normal spring temperatures, river stages become high, but there is no general flooding. In years when snow cover is heavy,

or when there is widespread lower elevation snow accumulation and a sudden warming in the spring, there may be higher than normal amounts of runoff that can lead to flooding.

Assessing the Risk of Severe Winter Storm

Severe winter storms are a frequent occurrence and a source of major concern throughout Colorado. The combined perils of snow, ice, freezing temperatures, and high winds pose multiple risks, including threats to public safety and the potential to cause major property damage and disruption to commerce. For example, winter storm conditions can threaten transportation safety during the event and result in snow or ice accumulations that can collapse roofs or topple trees. Planners should also be mindful of the impacts that severe winter storms may have on vulnerable populations, especially the homeless or those living in households without heat. There is no simple or universal approach to assessing these risks; however, a variety of data sources and tools are available to assist in the process of understanding the likelihood and potential impact of future storm events on the community.

Similar to other hazards, the local or regional hazard mitigation plan should be among the first sources to look for data and/or information on severe winter storms. The risk assessments included within these plans should have information on historical events, as well as information on any particular risks or vulnerabilities the community faces. If the severe winter storm hazard is considered a real threat to the community, then potential risk reduction measures should also be included as part of the mitigation strategy or implementation section of the plan (e.g, strategies to deliver resources to vulnerable populations in a storm's aftermath or strengthening building codes to enable new construction to withstand severe winter storms). When seeking professional assistance and advice on severe winter storms, planners should also consider turning to meteorology experts from organizations such as the nearest local office of the National Weather Service or institution of higher education. Another valuable source of information is the Office of the State Climatologist at the Colorado Climate Center at Colorado State University (http://climate.colostate.edu), which can provide additional weather and hazard risk-related data specific to each community.

Available Data Sources

Colorado Natural Hazards Mitigation Plan

The *Colorado Natural Hazards Mitigation Plan* is the State's FEMA-approved plan that serves as a foundation for the State's program to reduce risks to people, property, and infrastructure from natural hazards. The Plan is administered and updated by the Colorado Division of Homeland Security and Emergency Management. dhsem.state.co.us/emergency-management/mitigation-recovery/mitigation/state-colorado-natural-hazards-mitigation-plan

Colorado Climate Center

The Colorado Climate Center is housed in the Department of Atmospheric Science at Colorado State University. It is a source of useful information on natural hazards in Colorado and provides an excellent resource to learn about climate in Colorado. http://climate.colostate.edu/

National Centers for Environmental Information

The National Centers for Environmental Information (NCEI) was formed in 2015 as a merger of NOAA's three existing National Data Centers. This site is a rich data source for climate and historical weather information and contains historical event data on a host of natural hazards. A particularly helpful NCEI tool is the Storm Events Database which contains archived records on the nature and impact of notable storm events including blizzards, extreme cold, ice storms, and other winter weather as documented by NOAA's National Weather Service. ncdc.noaa.gov/stormevents

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U.S. Department of Labor, Occupational Safety and Health Administration

One role of the Occupational Safety and Health Administration (OSHA) is to provide information to the public to protect them from various natural hazards, including winter weather. osha.gov/dts/weather/winter_weather/hazards_precautions.html

High Plains Regional Climate Center

The High Plains Regional Climate Center aims to increase the use and availability of climate data in the region that includes Colorado as well as Kansas, North Dakota, Nebraska, South Dakota, and Wyoming. The Center's website provides temperature and precipitation overviews that can be graphically depicted on a state-by-state basis by county boundaries. hprcc.unl.edu

Rocky Mountain Insurance Information Association

The Rocky Mountain Insurance Information Association (RMIIA) provides historical statewide data regarding damage resulting from natural hazards. The RMIIA website also contains recommendations for local planners to consider more specific ways to assess and reduce winter storm-related risks in their community, such as burst pipes, ice dams, wind damage, leaky roofs, and building collapse caused by the weight of ice or snow. rmiia.org/catastrophes_and_statistics/Winter_Storms.asp

National Weather Service

The National Weather Service (NWS) is the official U.S. weather, marine, fire and aviation forecasts, warnings, meteorological, products, climate forecasts, and information about meteorology. NWS is a component of the National Oceanic and Atmospheric Administration (NOAA). NWS maintains a glossary of information on more than 2000 terms, phrases, and abbreviations used by the NWS and accepted as an excellent source of definitions of hazards (*National Weather Service,* 2009). https://w1.weather.gov/glossary/

Applicable Planning Tools and Strategies

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Applicable Planning Tools and Strategies – severe winter storm	
Addressing Hazards in Plans and Policies	• Comprehensive plan • Climate plan • Hazard mitigation plan • Pre-disaster planning • Resilience planning
Strengthening Incentives	*N/A*
Protecting Sensitive Areas	*N/A*
Improving Site Development Standards	*N/A*
Improving Buildings and Infrastructure	• Building code • Critical infrastructure protection
Enhancing Administration and Enforcement	*N/A*